

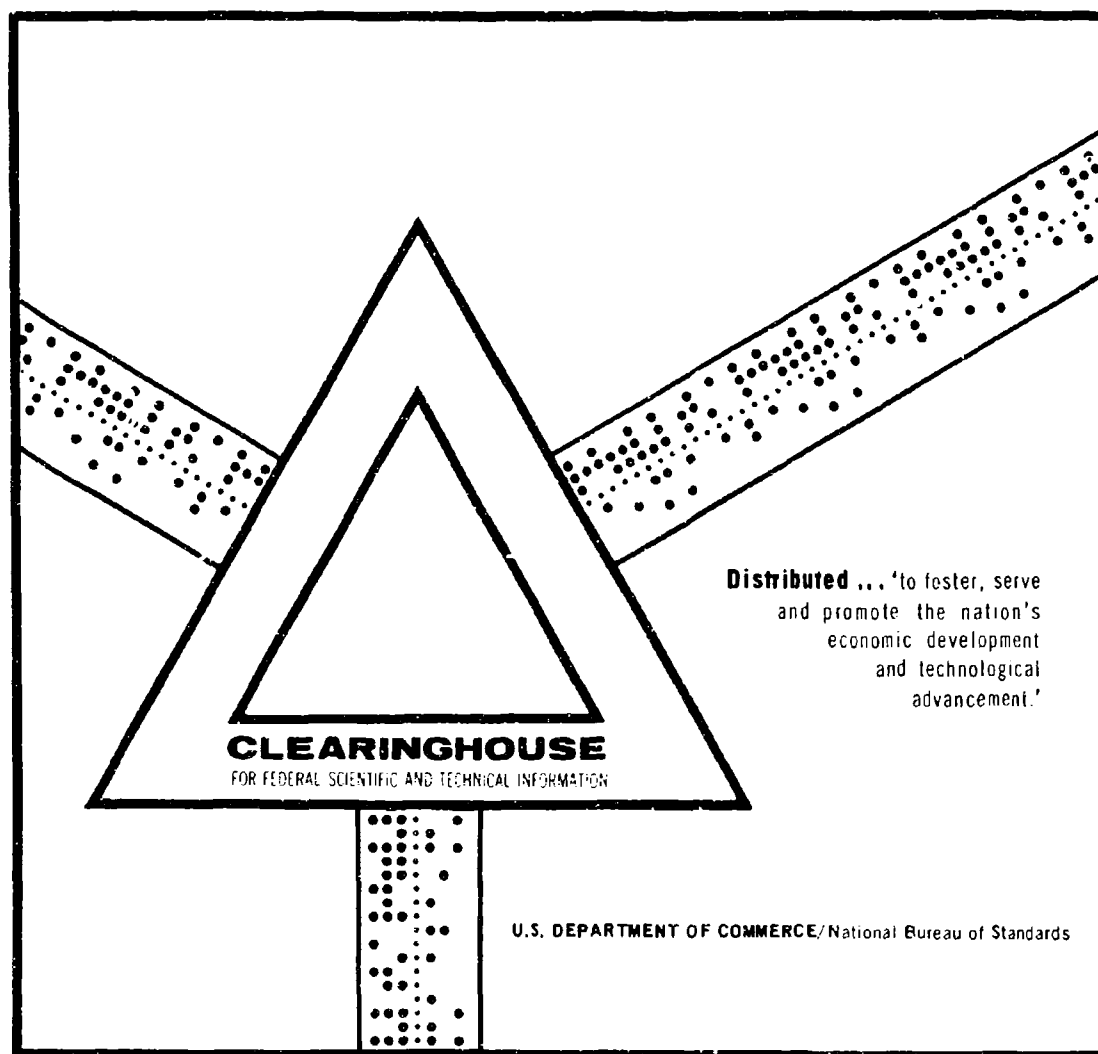
AD 697 792

SYNOPTIC APPLICATION OF SATELLITE CLOUD
PICTURES OVER THE FAR EAST

K. S. Pak

Weather Wing (1st)
San Francisco, California

October 1969



This document has been approved for public release and sale.

AD 697792

TECHNICAL STUDY 19

SYNOPTIC APPLICATION OF SATELLITE CLOUD PICTURES OVER THE FAR EAST

BY
K. S. PAK



OCTOBER 1969

SCIENTIFIC SERVICES
HQ 1st WEATHER WING
APO SAN FRANCISCO 96553

D D C
RECEIVED
DEC 11 1969
C

CREATED HOUSE
HOLDING

THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC
RELEASE AND SALE: ITS DISTRIBUTION IS UNLIMITED.

ACCESSION FOR		WHITE SECTION <input checked="" type="checkbox"/>
CPRTI		DIFF SECTION <input type="checkbox"/>
DOB		<input type="checkbox"/>
UNANNOUNCED		
JUSTIFICATION		
BY		
DISTRIBUTION/AVAILABILITY CODES		
DATE	AVAIL. MOD. OF	SPECIAL
/		

Technical Study 19

SYNOPTIC APPLICATION OF
SATELLITE CLOUD PICTURES
OVER THE FAR EAST

by

K. S. Pak

Scientific Services
Hq 1st Weather Wing
APO San Francisco 96553

October 1969

THIS DOCUMENT HAS BEEN APPROVED
FOR PUBLIC RELEASE AND SALE:

ITS DISTRIBUTION IS UNLIMITED

ACKNOWLEDGMENTS

The author wishes to acknowledge the generous support of the 20th Weather Squadron, 1st Weather Wing, USAF, especially Lt Col Harold B. Hart and Mr. George Taniguchi, who reviewed the manuscript and made helpful suggestions.

LIST OF CONTENTS

- A. Introduction
- B. Characteristics of Clouds Seen in Satellite Pictures
 - 1. Brightness
 - 2. Patterns
 - 3. Structures
 - 4. Texture
 - 5. Shape and Size
 - 6. Cumuliform Clouds
 - 7. Stratiform Clouds
 - 8. Cirriform Clouds
 - 9. Other Characteristics
- C. The Topographical Effects of Cloud Formations
 - 1. Local Effects
 - 2. Frictional Effects with Pressure Patterns
- D. Similar Reflectivity from the Surface
- E. Clouds Associated with Fronts and Waves
 - 1. With Cold Fronts
 - 2. With Warm Fronts
 - 3. With Stationary and Occluded Fronts
 - 4. Others
- F. Clouds Associated with Extratropical Cyclones and Anticyclones
- G. Clouds Associated with Jet Stream
- H. Cloud Formation in the Tropics
- I. Cloud Formation in the Plateau Areas
- J. References

A. Introduction

Satellite cloud observations have proven to be a powerful tool for the meteorologist in describing current states of the atmosphere. This study describes the application of satellite data in daily synoptic analysis and forecasts. General characteristics of the appearance of clouds in satellite pictures are discussed briefly (Reference: WMO Technical Note No. 75, "The Use of Satellite Pictures in Weather Analysis and Forecasting"). Rules which are directly useful for daily forecasting are itemized and divided into various terrain effects and synoptic patterns. Selected examples are photographs from ESSA 2, 4 and Nimbus 2 taken over the Far East, west of 180° longitude from March 1966 to March 1968, and received by the Fuchu TVQS.

B. Characteristics of Clouds in Satellite Pictures

1. Brightness: Generally increased brightness is associated with thicker clouds, especially in cloud systems associated with cyclones. Water-droplet clouds always appear brighter than ice clouds of the same thickness. Tone of high clouds are light gray or white. Brightness of the cloud is dependent on the sun angle and vertical extent. The brightest layers are often associated with nimbostratus, thick stratus or fog and clouds producing precipitation. The results from Conover's study, arranged in order of decreasing brightness, are shown in Table 1.

2. Patterns: The smallest cloud elements visible in a satellite picture are either randomly distributed or are organized into mesoscale cloud formations which form a pattern. One of the most striking patterns is the one produced in cumulus clouds by mesoscale cellular convection (see Fig 1). This pattern occurs in great variety, especially over the oceanic areas of the world. Clouds are also commonly observed as small lines or bands (see Fig 2) which have their own distinct pattern. Gravity waves near a jet stream, or mountain lee waves, produce patterns of banded clouds which are easily recognized in the satellite pictures.

3. Structures: Shadows and highlights are often quite helpful in identifying cloud structures; that is, the relative heights of the different clouds viewed (see Fig 3-1 and 3-2). Shadows can be used to identify the edges of cirrus and high-level altostratus cloud sheets. The structure of clouds is also revealed when low cloud formation can be detected beneath a higher layer of translucent middle or high cloud. Both of these indications of structure are important in identifying certain cloud types and in making synoptic assessments of large-scale cloud formations.

4. Texture: Cloud surfaces, when viewed from above, often vary in degree of apparent smoothness. This characteristic is referred to as the texture of the clouds. Cloud masses which have smooth appearing surfaces are usually quite flat on top and have little variation in their thickness (see Fig 4-1 and 4-2).

5. Shape and Size: All cloud forms vary in shape and size. The edges of cloud formations can be rounded, straight, serrated, scalloped, jagged, or diffuse. The patterns can be arrayed in straight or curved band intersecting or isolated from other patterns. These characteristics also are important for identifying cloud types.

6. Cumuliform Clouds: Cumuliform groups can either be organized into patterns of cells, bands or lines (see Fig 5), or be randomly distributed (see Fig 6). However, some convective type clouds do not have these characteristics. For example, the area where fair weather cumulus clouds are present may appear only as a light shade of gray in a picture; the cumuliform characteristics mentioned above are therefore lacking. Cumulonimbus clouds are very bright masses which are fully developed and are indicative of squall lines or thunderstorms. They are usually of medium size, unbroken, and of uniform appearance; are often separated or completely isolated from other cloud covers; and range from 100-200 miles in length. When not deeply imbedded in other clouds, these clouds appear as bright blobs 5-20 miles in diameter, or in patches up to 50 miles or more across (see Fig 4-1 and 4-2).

7. Stratiform Clouds: Stratiform cloud areas normally lack organized pattern and texture (see Fig 3-1 and 3-2). Clouds which are identified in pictures as stratiform generally occur under stable conditions. Cloud types which have a stratiform appearance from above are thick stratus or fog, thick alto-stratus or nimbostratus, and thick cirro-stratus; the latter especially when it occurs above another cloud layer.

8. Cirriform Clouds: Cirriform clouds when viewed from above have a distinct fibrous appearance (see Fig 7). A cloud layer thin enough to allow lower clouds or landmarks to be detected beneath it is usually cirrostratus. Cirriform cloud formations can also be recognized by their association with other cloud types such as cumulonimbus.

9. Other Characteristics: Cumuliform clouds less than a mile in diameter resemble stratiform clouds on satellite cloud pictures (see Fig 8), as the camera is unable to resolve the clouds as individual elements. The whitest clouds in the Tiros picture are usually the coldest.

C. Topographical Effects on Cloud Formations

1. Local Characteristics:

a. Parallel lines of low cumuliform clouds tend to form along long, deep valleys, rugged mountains and narrow straits adjacent to shore-lines, and are found in association with circulation about extratropical cyclones or northwest monsoonal flow (see Fig 9). Large scale parallel lines of cumuliform clouds are usually observed downstream east of Japan.

b. Clouds formed in areas of weak pressure gradient are influenced by topography, and considerably affected by the monsoon wind and sea breeze.

c. Locally formed clouds along coast lines are caused by differential heating, differential friction, orographic lifting, or any combination of these (see Fig 9). Clouds caused by only one of these normally do not persist as long as frontal clouds.

d. Hills, mountains and islands often provide clues in identifying clouds as low stratus and fog (see Fig 7). The shadows cast by higher clouds on top of the fog or stratus also provide an additional clue that a cloud layer is relatively low.

e. Orographic effects due to mountains on low clouds are easily recognizable on satellite photos. Effects on high clouds are more difficult to detect. Upslope cloudiness and clearing in areas of strong downslope motions on the leeward side are discernible in satellite photographs. Lee wave clouds are normally parallel bands of straight or curved stratocumulus and/or cumulus clouds downwind from hills or ridges, at altitudes not significantly greater than 10,000 feet (see Fig 9).

2. Frictional Effects with Pressure Patterns:

a. Most patterns in low-level clouds are determined by the condition of the underlying surface and are produced by a combination of differential heating and differential friction. Consider a wind flow parallel to the east coast of a land mass in the northern hemisphere, with the flow from the south (see Fig 10A), and low pressure to the west. Since the reduction in wind speed due to friction is greater over land than over water, the retarded southerly flow over land is deflected to the west by pressure forces while the winds over the water continue to flow swiftly parallel to the coast. The result is a zone of divergence along the coastline. Conversely, if the low-level flow is from the north (see Fig 10B), with low pressure to the east, the slower winds over the land are diverted toward the east and produce a zone of convergence along the coast where the winds are turning cyclonically and meet the stronger northerly flow.

D. Similar Reflectivity from the Surface

1. In case of strong reflectivity, it is often difficult to distinguish clouds over extensive areas of snow and ice from the equally white surface below. Therefore, users should be aware of areas of icy surfaces and snow-covered terrain. Fig 11 is an example of frozen LAKE BAIKAL.

2. Cumuliform clouds and small isolated areas of snow such as the snow-covered tops of mountains appear much the same when viewed from above (see Fig 12).

3. The tops of mountain ranges form a white dendritic pattern, and snow-covered grassland appears much whiter than forestland covered with an equal amount of snow.

4. In the dryer climates of the world (deserts, bare hill, etc.), sparse vegetation combined with red and yellow soils and rocks make the earth's surface highly reflective. These conditions produce the brightest terrain seen in satellite pictures (see Fig 13). The alkaline and saline materials that form the bottoms of dry lake beds are particularly reflective and have been mistaken for cloud formations.

5. From continual satellite cloud pictures, we can spot areas with different sea surface temperatures. Advection of warm air over cool sea surface will cause clouds or fog to form over this surface.

E. Clouds Associated with Fronts and Waves

1. With Cold Fronts:

a. Clouds associated with a cold front form mostly to the rear of the front, and those associated with a warm front form in front of it (see Fig 14).

b. Clouds associated with an active cold front are generally a combination of both stable and unstable cloud types. These frontal bands average three degrees of latitude in width and have a clear-cut edge on one or both sides where cloud type, and often cloud amount change abruptly. Fig 15 illustrates clouds associated with an active cold front over the ocean. Fig 16 is an example of this over the China mainland. A widening of the frontal band with a bulge toward the warm air side usually indicates that a jet axis is crossing the front at this point (see Fig 17).

c. Post-frontal instability line or secondary frontal cloud bands are generally parallel with a cold frontal band and are located behind it; that is, it is the western most cloud band or one of several such bands. The bands may be separated by an area of striated clouds, or by a completely clear area. Fig 18 shows the clouds associated with the beginning stage of secondary cold front, and Fig 19 is an example of the clouds for a topographically decayed secondary cold front.

d. The weak cold frontal band located in the rear of the upper trough line is much narrower and sometimes appears ragged and full of breaks. This portion of the air aloft is sinking, and this area is composed mostly of cumuliiform cloud (see Fig 20).

2. With Warm Fronts:

a. Generally, clouds associated with a warm front form over a wider area than those associated with a cold front, and stratus clouds forms at the low level (see Fig 21). However, hardly any clouds are associated with a warm front in the interior of the dry continent over Mongolia and Manchuria, especially during frontogenesis (see Fig 22).

b. The warm frontal cloud bands are associated with a zone of maximum baroclinity (see Fig 23), the area where the front is steepest.

3. With Stationary and Occluded Fronts:

a. As shown in Fig 24, clouds associated with stationary fronts form over a comparatively wide area along the front (300-600 nautical miles wide in the case of a Baiu front). However, there are crevices and broken clouds along the south side of the front, and also to the rear of waves.

b. Generally, clouds associated with a stationary front are more extensive than in the case of a moving cold front. However, when a wave or small cyclone forms on the stationary front, the cloud area increases, but becomes broken near the center of the small cyclone (see Fig 24).

c. The width of the cloud associated with the stationary polar front (including the case with wave formation) located just to the south of Japan and in the vicinity of Okinawa is usually 280-330 nautical miles.

d. Fig 25 shows clouds, usually spiral or circular shaped, associated with an occluded front.

4. Others:

a. An instability line ahead of a frontal band is often differentiated from the band by the scalloped edges of the instability clouds, and by the presence of massive clouds with a curved alignment. In Fig 14, the squall line is clearly delineated as a long, narrow band of cloudiness ahead of the frontal band.

b. The formation of a wave on a frontal cloud band is indicated in satellite pictures by a widening of the frontal cloud band toward the cold side (see Fig 26). In the early stages of wave development, no recognizable circulation center is visible in frontal clouds.

c. Once in a while, a shadowlike line is seen to the rear of an active cold front (see Fig 27). It can extend 1500 nautical miles or more parallel to the front.

F. Clouds Associated with Extratropical Cyclones and Anticyclones

1. Cloud patterns of the beginning state of an occlusion or the regenerating stage of a cyclone are crescent or comma shaped with bright, heavy overcast, middle and/or high clouds having either an amorphous or "pebbled" appearance. These patterns are usually without low and/or middle level clouds spiraling into the central region of the pattern from the northwest. The center of the circular cloud patterns are normally vertical to the cyclone center of the surface chart (see Fig 28).

2. Cloud patterns associated with occluded cyclones are hook shaped, bright, heavy overcast of middle and/or high clouds with spiraling low and/or middle clouds inside the hook. This pattern differs from the crescent shaped pattern by the presence of spiraling low to middle level clouds inside the hook. The low level clouds are usually cumuliform and, at this stage, the clouds are still nearly vertical over the cyclone center on the surface chart (see Fig 29).

3. Fully occluded mature stages of cyclones are cyclonically curved middle and/or high cloud bands, with a heavy overcast area in the northeastern quadrant and striated, broken areas in the southwestern quadrant, usually with low to middle level spiral clouds. Spiral low and middle cloud patterns may appear near the circulation center. The center cloud system is usually located 100 to 300 nautical miles to the rear (west or south) of the cyclone center on the surface chart (see Fig 2).

4. A decaying cyclone is depicted by spiraling low and/or middle clouds, with an appearance of decreasing organization. Such a cyclone may or may not be associated with an active frontal system. Fig 30 is an example of the decaying stage of an Aleutian low which normally has a vertical axis.

5. In most cases, clouds are not observed with non-persisting, weak lows which form over the Sea of Japan. Even if clouds are formed, these are limited to only scattered lower clouds.

6. The spiral cloud bands which form the cloud wall in a well-developed cyclone are shaped like a funnel near the center (see Fig 27).

7. Clouds associated with cold fronts move toward the center of the cyclone (see Fig 31), and form a circular shape. In this stage, south-north oriented and well developed convective cloud can be seen to the rear of the circular-shaped cloud pattern. The cyclonic circulation forming on the top of the cloud can be seen from the movement of the cloud situation.

8. A well developed cyclone with a warm front parallel and to the south of Japan will have an extensive cloud cover extending toward the mountain range. The cloud cover will persist until the cyclone and the associated upper trough moves off toward the east (see Fig 32).

9. As shown in Fig 7, comparatively thick (2,000 feet over Okhotsk Sea) fog or stratus clouds are associated with a maritime cold anticyclone (e.g., Okhotsk high). Due to topographical effects, drizzle is also common.

10. It appears that there is no relationship between cloud patterns and topographically formed cyclones and anticyclones (e.g., formed over mountains area of the central Japan), especially with respect to the time of formation (see Fig 33).

11. With the formation of a Shanghai low, extensive cloud formation can be seen over land and sea (see Fig 34).

12. When cold air is advected over warmer ocean, cumuliform clouds are widespread over the ocean, and snow or rain showers occur along the wind-ward side of coast lines (see Fig 35) in winter.

13. Small-scale vortices related to flow of air over and around islands are sometimes observed in satellite pictures. These cloud features appear as arcs, eddies, or complete spiraling patterns downward from islands. The cloud features can frequently be seen as a broken area and are associated with a layer of stratocumulus or stratus below an inversion, with low wind speeds and ceilings (see Fig 36).

14. Advection fog or stratus often forms to the rear of migratory highs (see Fig 37).

G. Clouds Associated with Jet Stream

1. Cloud formation associated with the jet stream can be correctly identified from satellite photos eight out of ten times. This makes it possible to locate the jet stream axis quite accurately from the pictures (see Fig 36). These clouds extend over 300 to 1200 nautical miles.

2. In most cases, jet streams can be expected with cirriform clouds to the east of the trough line and on the tropical side of the jet axis. This cloudiness occurs either in the form of an extensive cirrus shield that ends abruptly along the jet axis or in the form of long narrow-bands (see Fig 38).

H. Cloud Formation in the Tropics

1. A crescent or comma shaped cloud forms with an intensifying tropical storm (see Fig 39).

2. Tropical cyclones tend to occur in the intertropical convergence zone (transition area from cloudless to cloudy conditions) (see Fig 40). With strong equatorial westerlies, tropical cyclones may occur simultaneously in both hemispheres.

3. Convergence lines or zones of heavy bands of cloudiness are seen to occur over ocean areas where tropical cyclones are likely to develop. These clouds normally move east-northeastward and appear to persist (see Fig 40). These clouds are formed by the warming of the cold air over the warm sea. A one to two degree ($^{\circ}\text{C}$) temperature difference is all that is needed for the cloud formation.

4. From satellite cloud pictures taken during summer, movements of thin clouds from the southern to the northern hemisphere, near the Caroline and Marshall Islands can be seen (see Fig 40).

5. Frontal cloud bands become narrow with the approach of a typhoon (see Fig 41).

6. During early summer, tropical cyclones do not accompany any frontal clouds (see Fig 42) until they move over land and take on the characteristics of an extratropical cyclone (see Fig 43).

7. During autumn, a tropical cyclone which has moved into mid-latitude regions, usually merges with a frontal cloud system (see Fig 44).

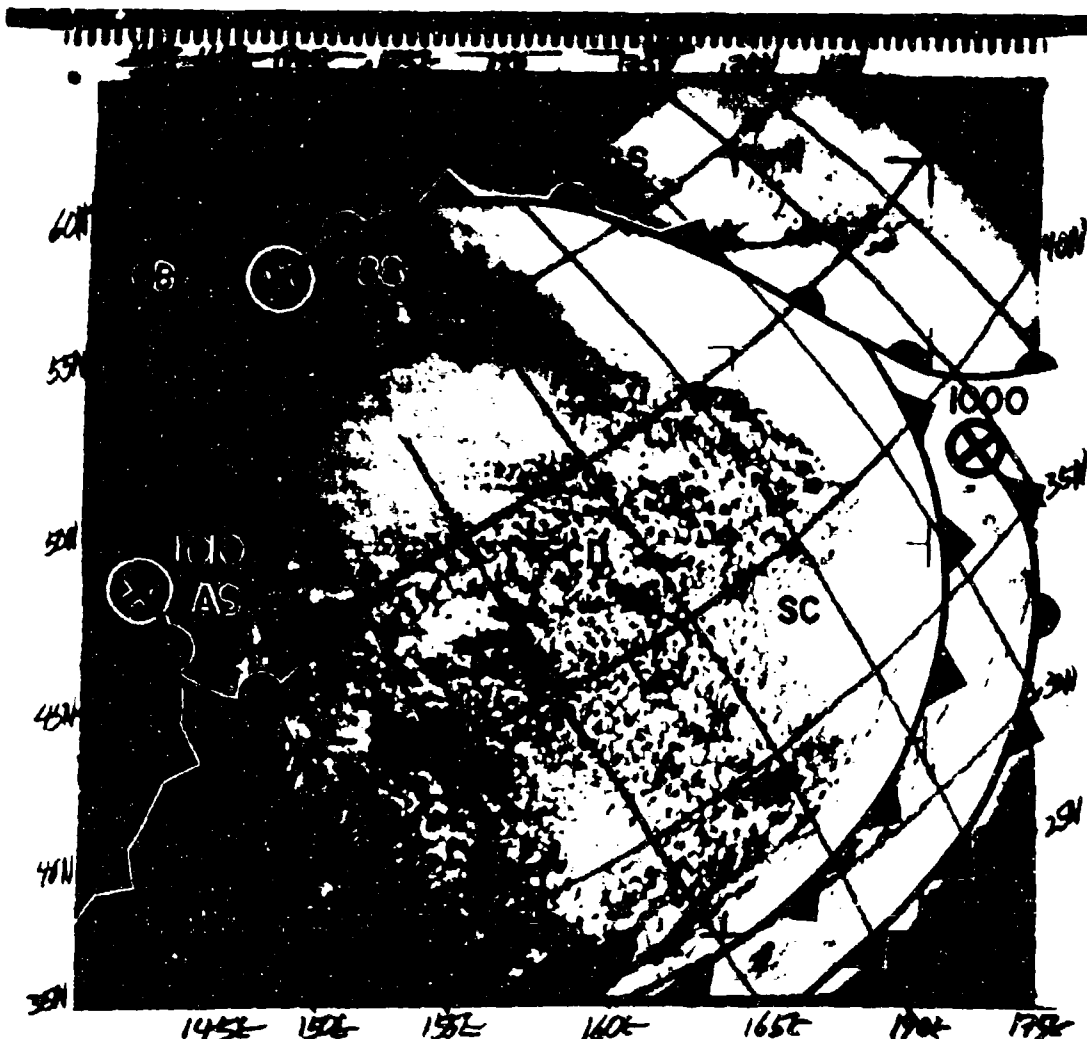
8. With strong equatorial westerlies, tropical cyclones occur with a high frequency (see Fig 45).

I. Cloud Formation over the Plateau Area of Tibet

1. Cloud distribution over the plateau area is frequently observed to be about 120-300 nautical miles to the rear of the surface low pressure center (see Fig 46), e.g., the spiral cloud associated with a cyclone is preceded about 150 miles by the surface low center.

2. The occluding cyclone over the plateau or desert area is very hard to detect from surface and upper air charts, but is readily discernible from the satellite cloud picture (see Fig 47).

3. Generally clear skies are associated with stationary or early stages of cyclones over the plateau area (see Fig 48). On the other hand, comparatively thick cloud layers are seen with migratory cyclones (see Fig 49).



BY THE AS. JAPAN

2

24 Dec 63 21:32:22

1. 2572 PIC 1.2.60

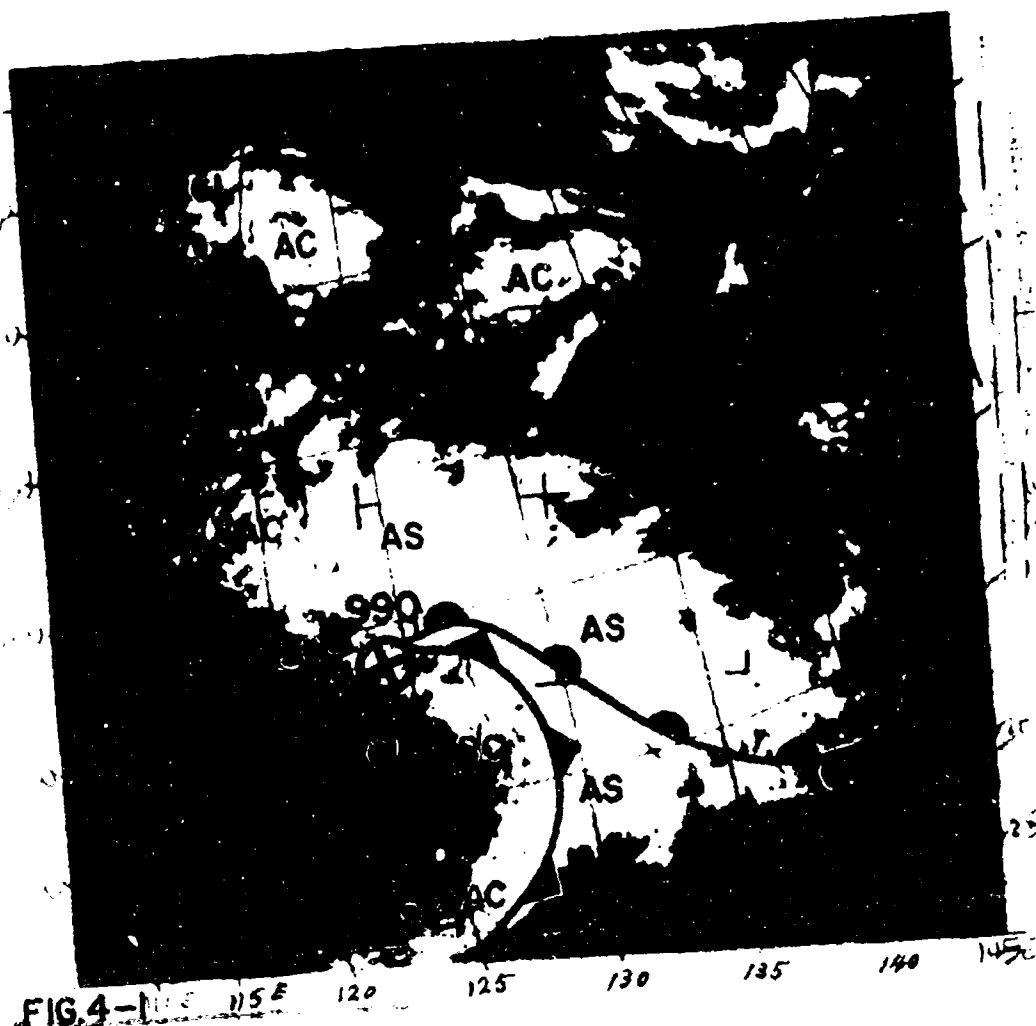
THIN KISS



FIG. 3-1

120 E





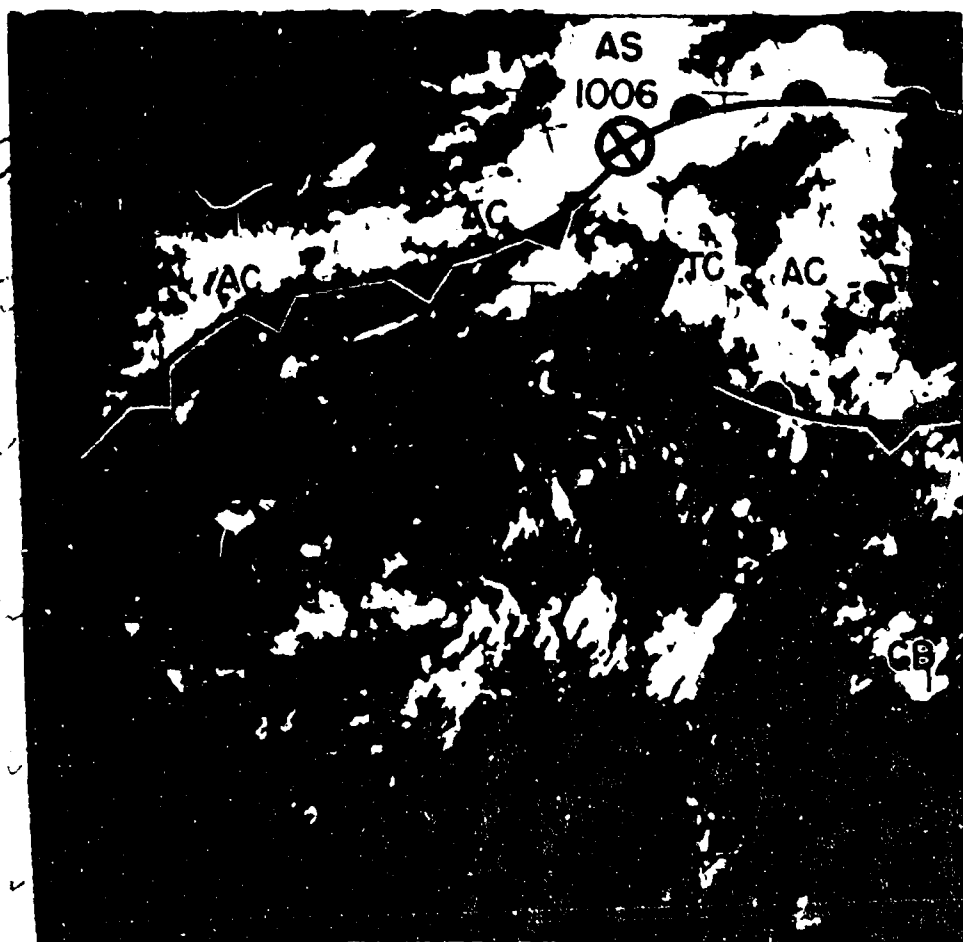
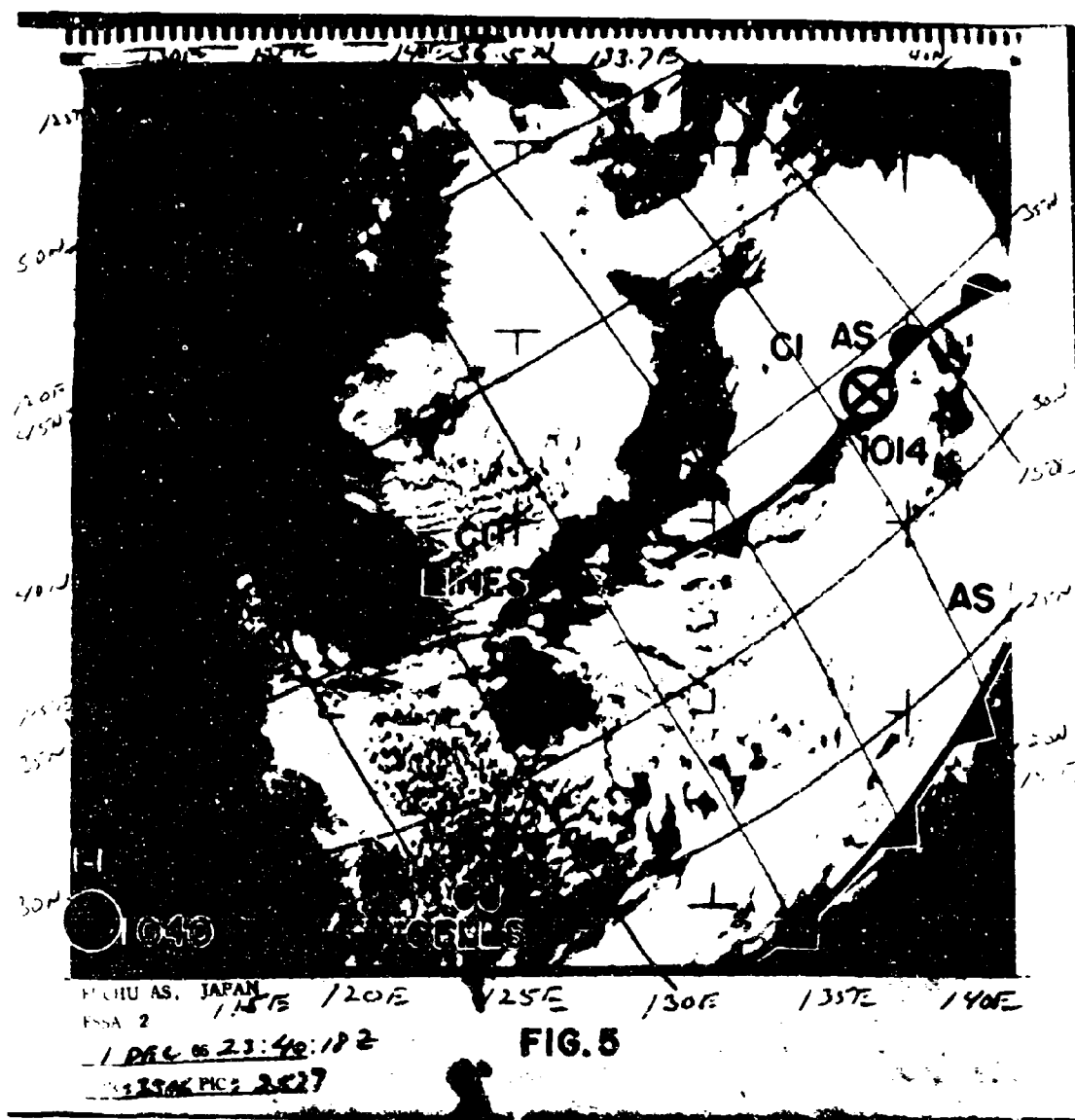


FIG. 4-2110 115 120 125 130 135



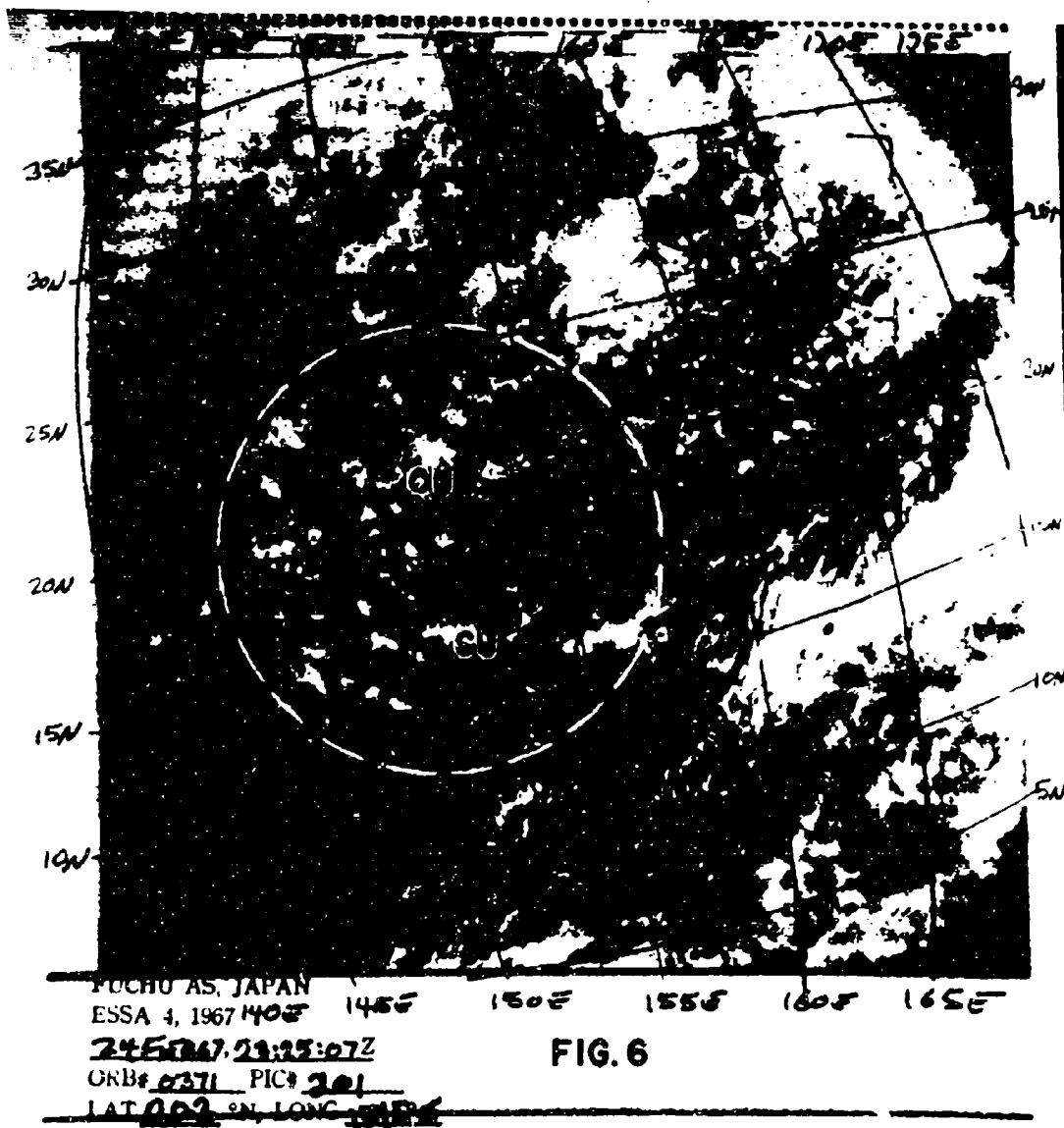
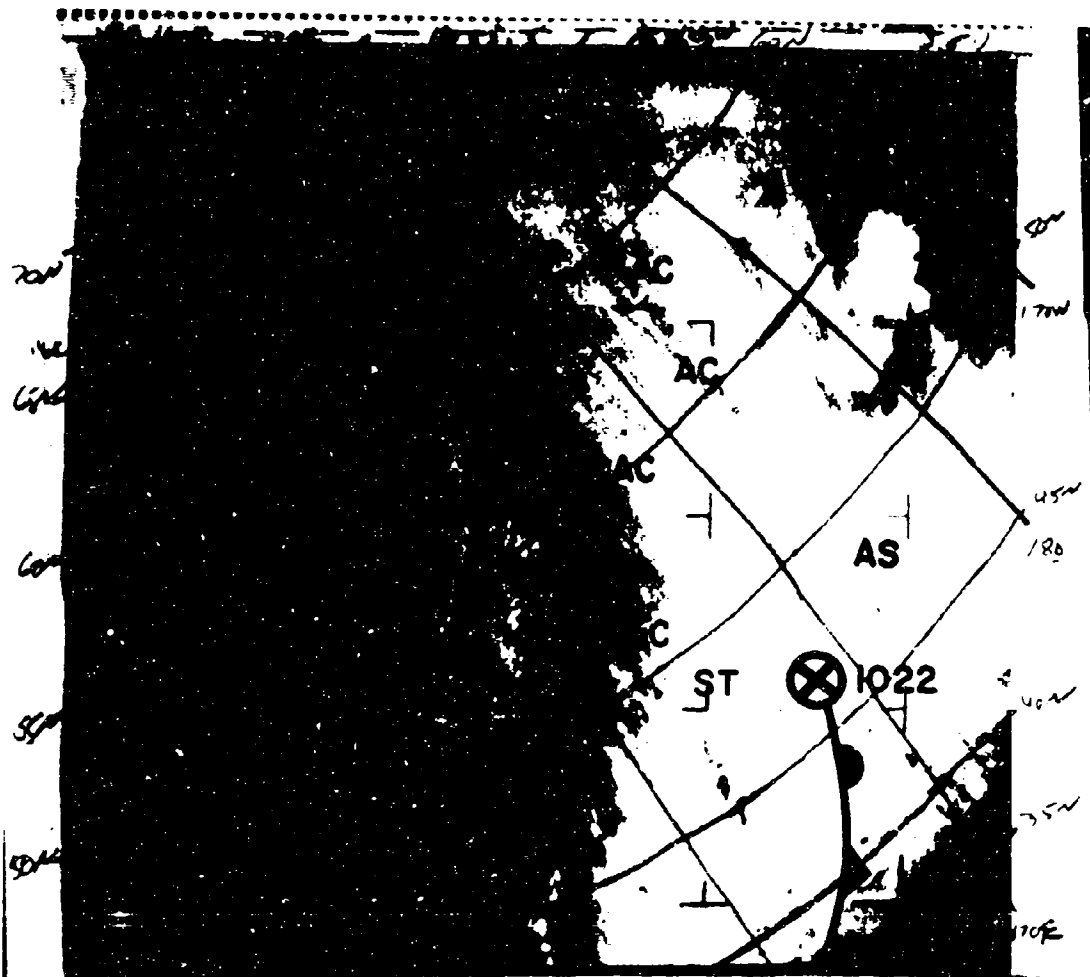


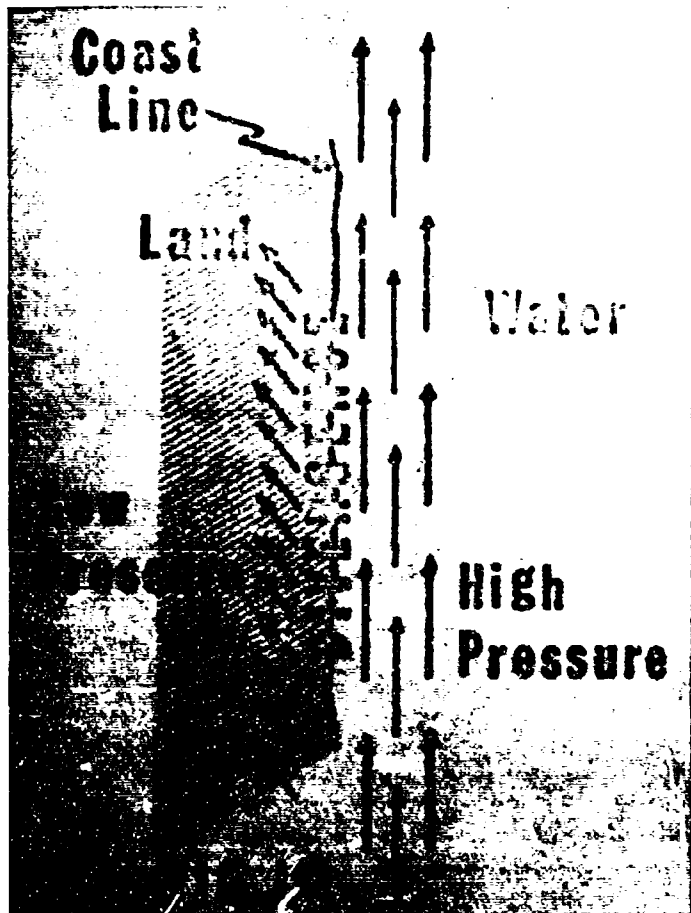
FIG. 6

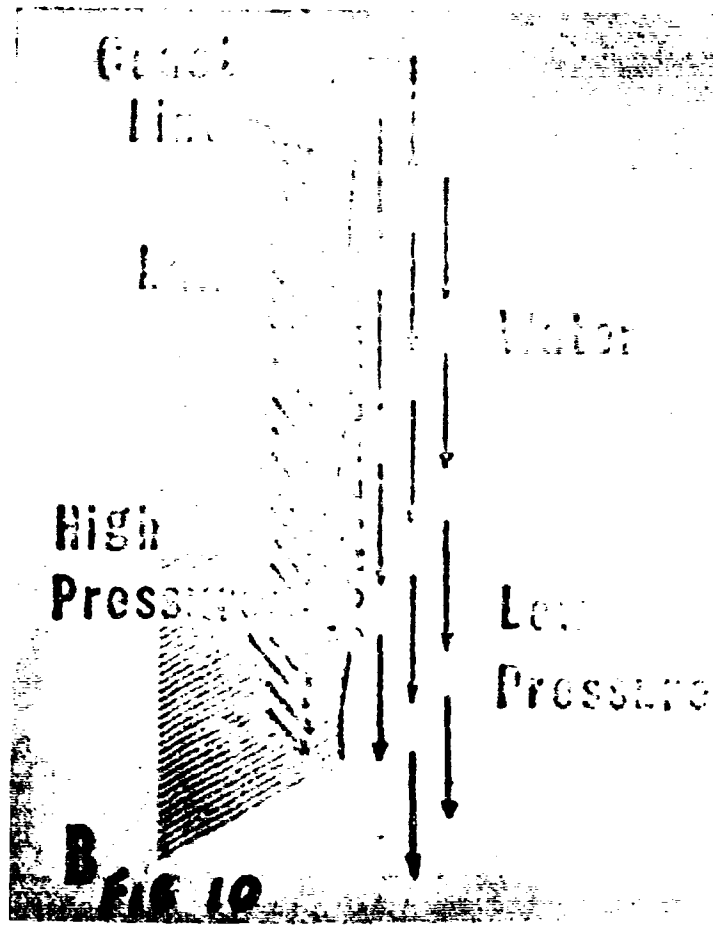


1022 AS JAPAN 140E 45N
 1022 AS JAPAN 140E 45N
 1022 AS JAPAN 140E 45N
 1022 AS JAPAN 140E 45N

FIG. 8







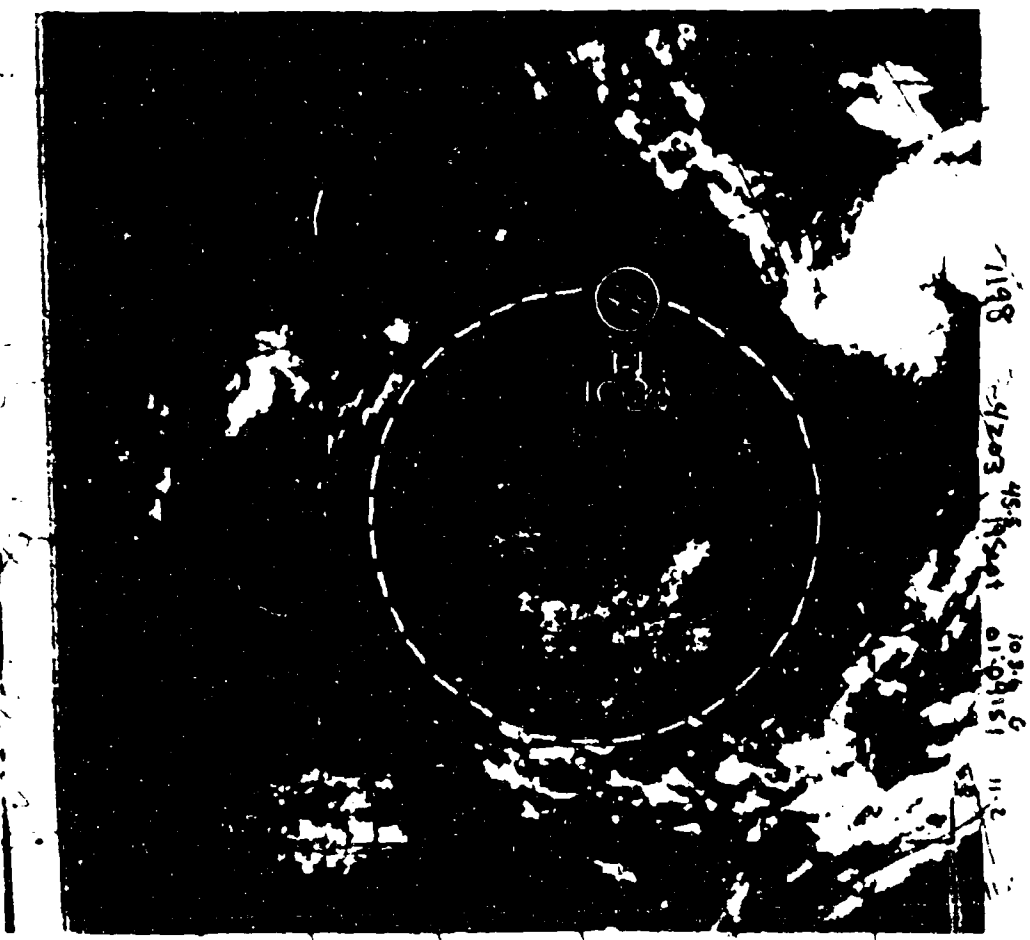
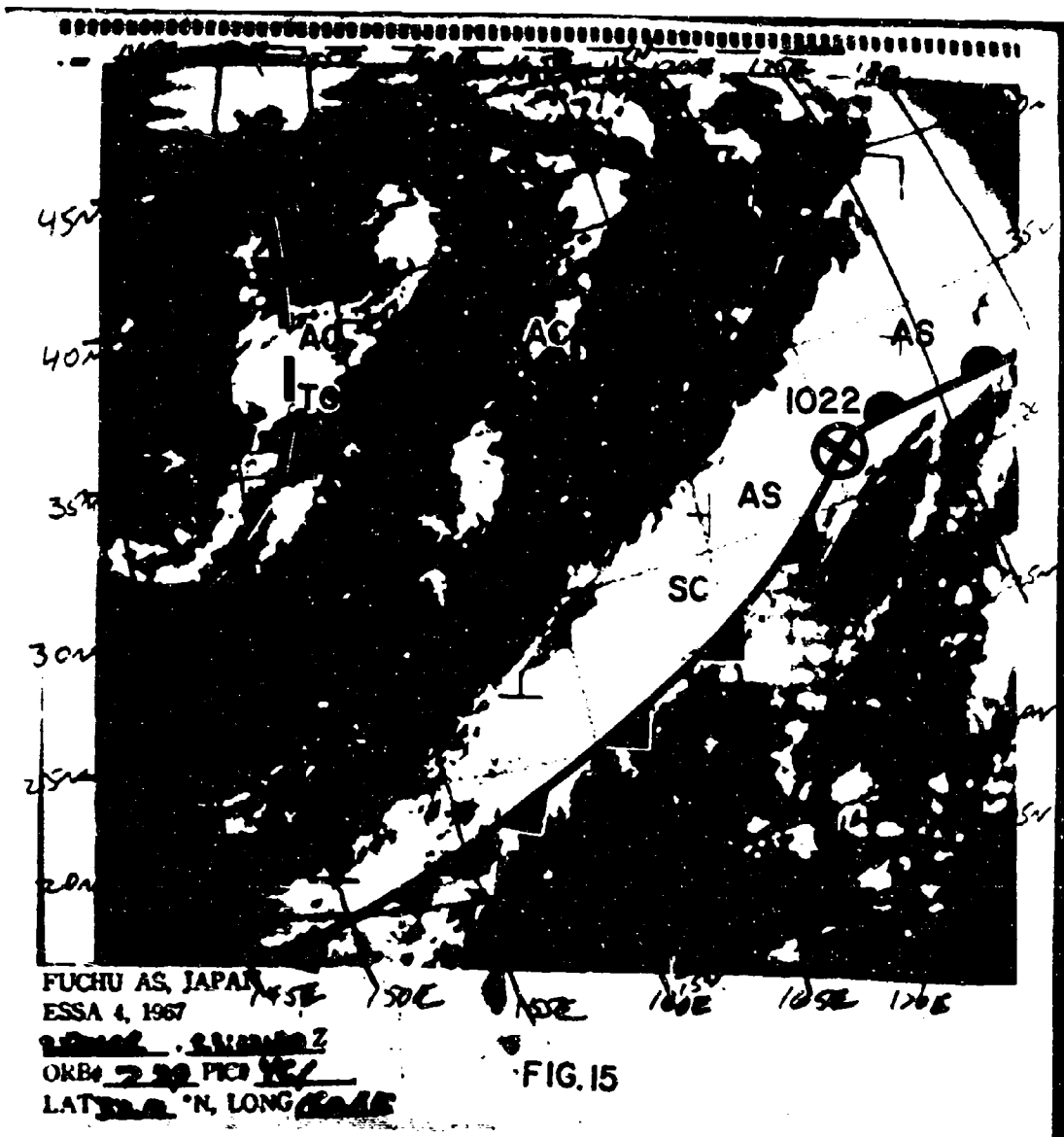


FIG.13 85E 90 95 100 105 110E



FUCHI, AS, JAPAN
 ESSA 4, 1967
29 JAN 67, 23:11:28Z
 ORISA 0041 PIC# 2
 LAT 34.5°N, LONG 169.7E

FIG.14



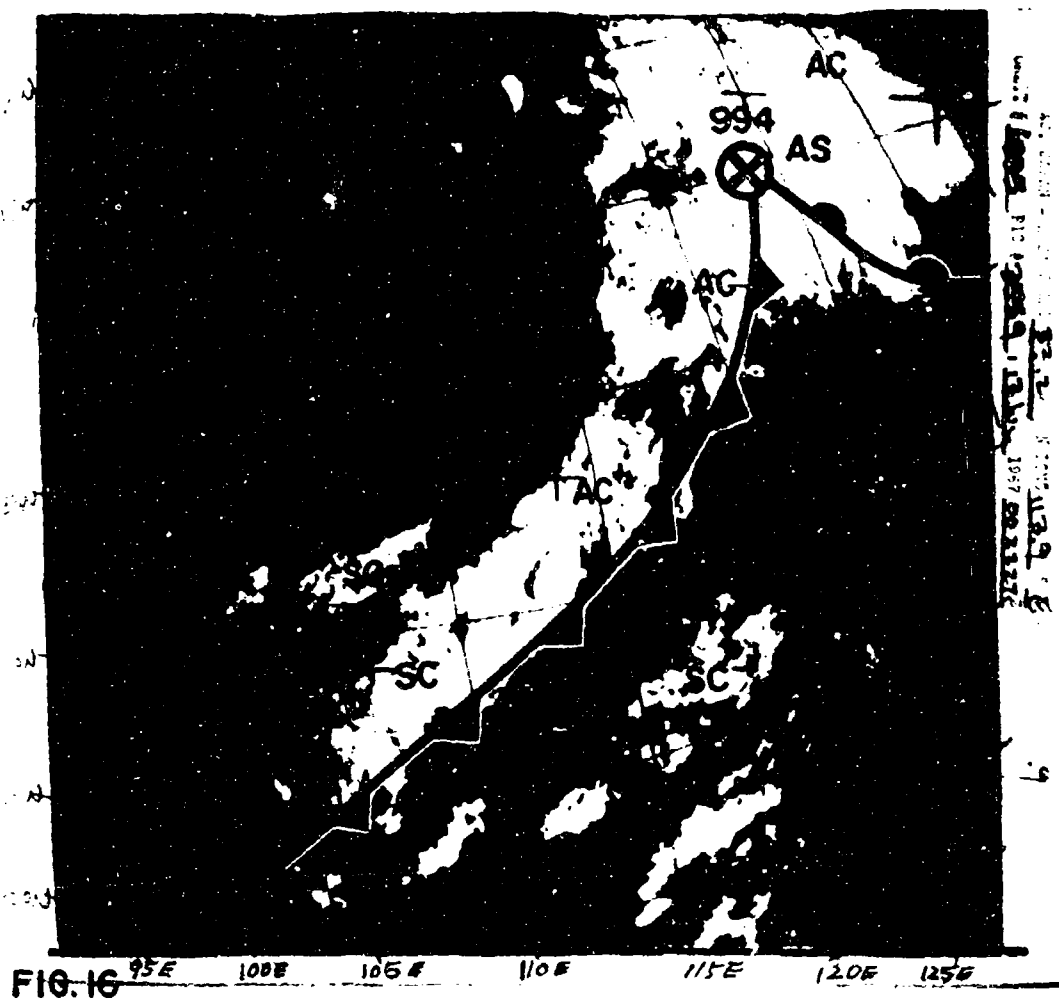


FIG. 16



FIG. 18

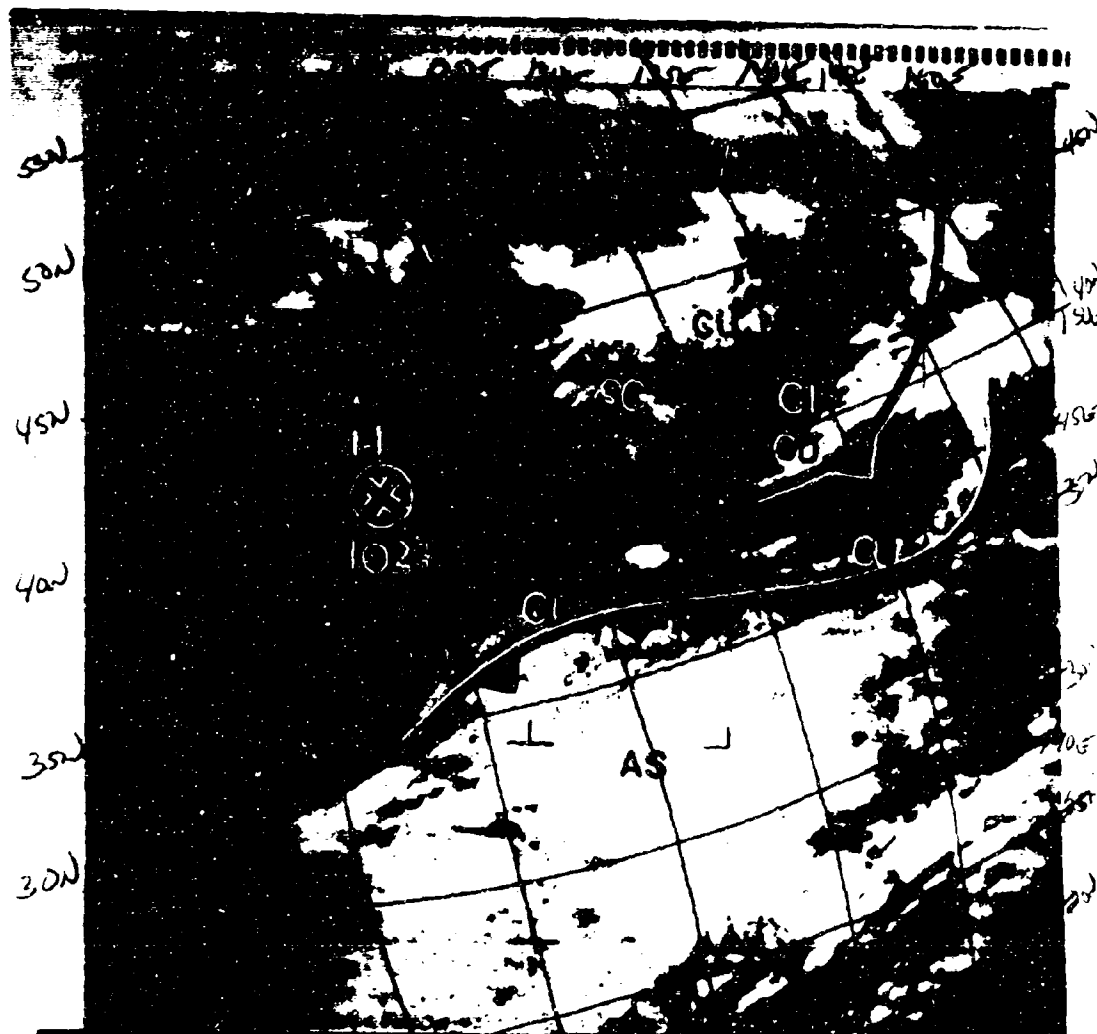
FIG. 18

FIG. 18

FIG. 18

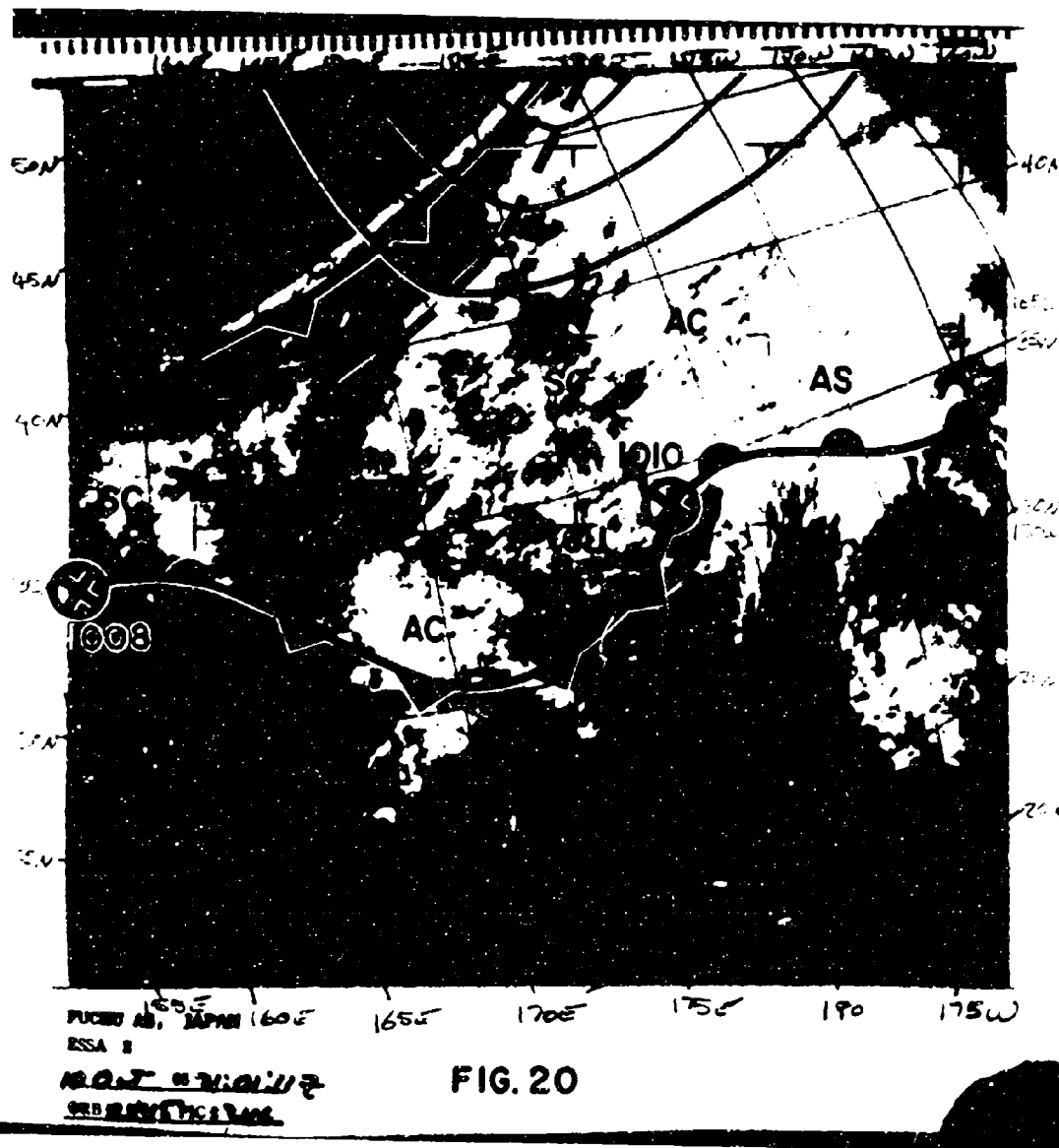
FIG. 18

FIG. 18



FUCHU AS JAPAN
 ESSA 4, 1987
 CAPRI 02:00:02 Z
 ORB 02:00:02 PICT 5:00
 LAT 30° N LONG 125° E

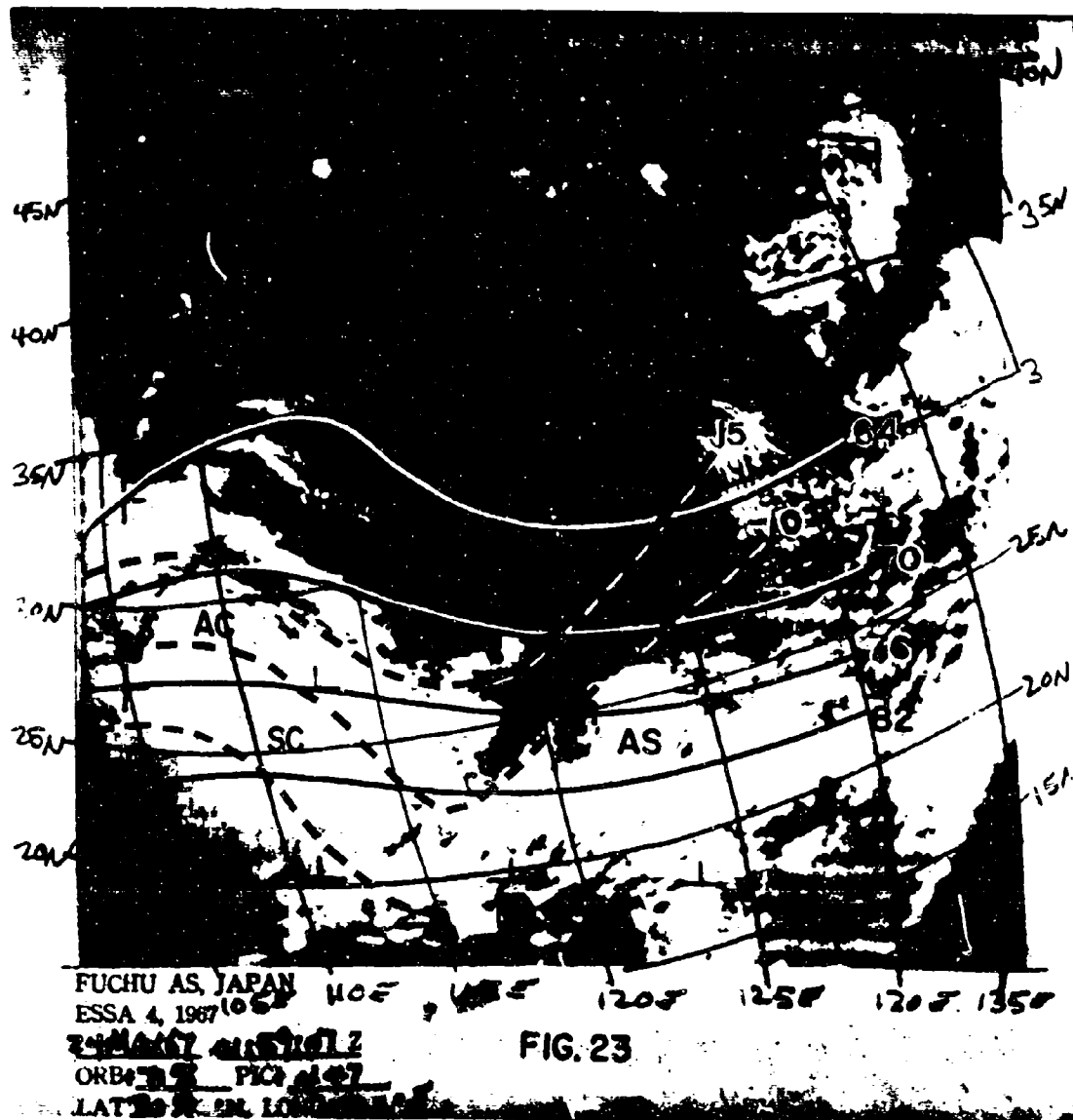
FIG.19

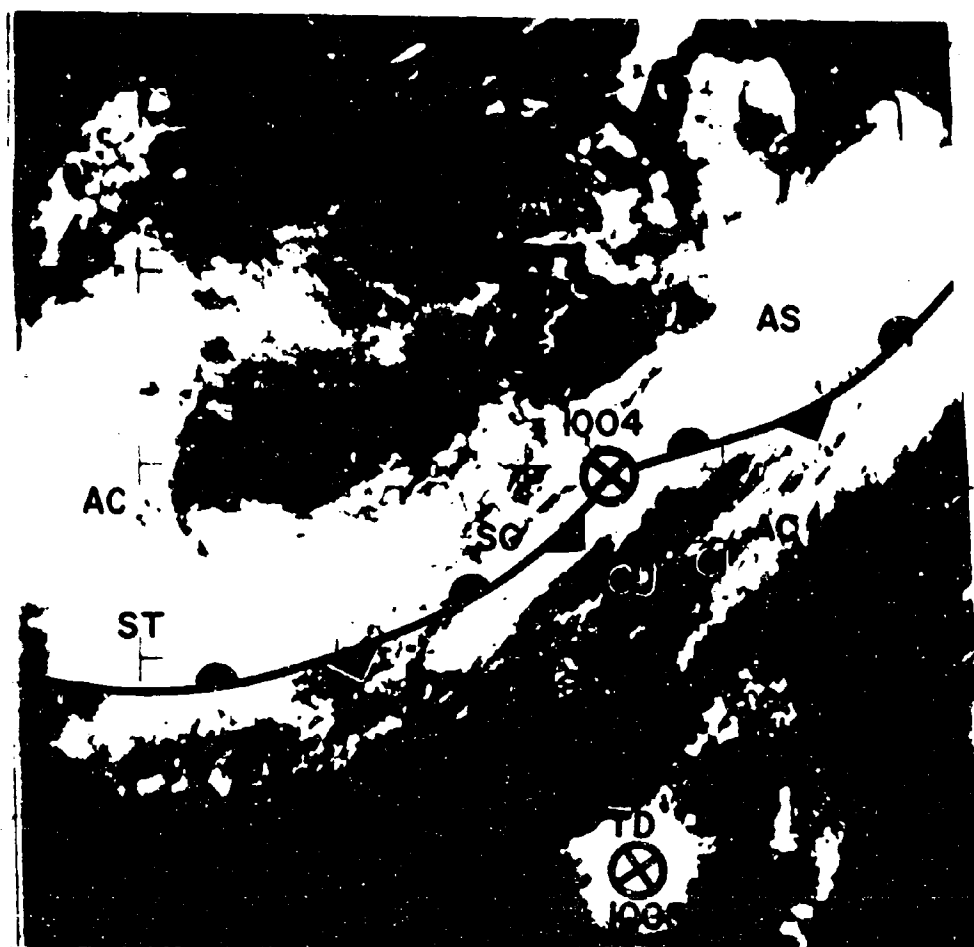




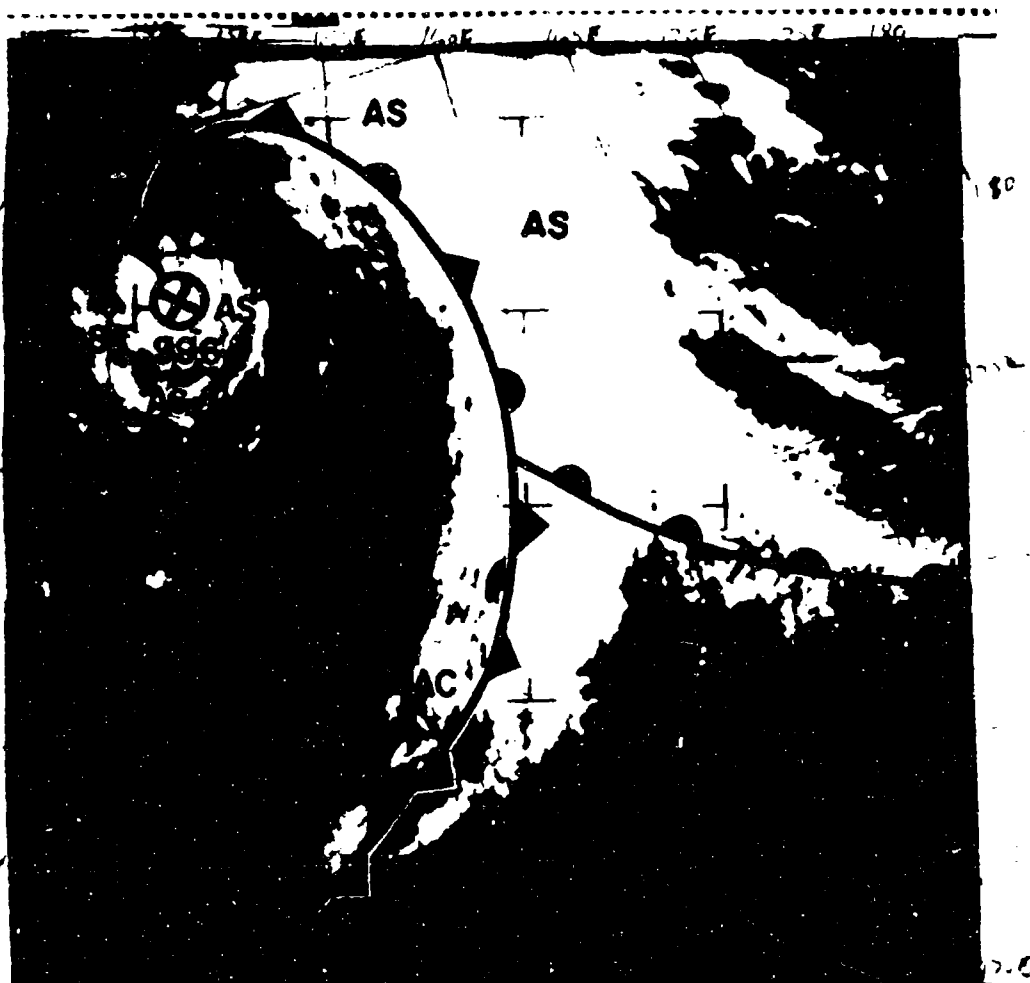
FUCHU AS, JAPAN
 18 MAR 23:0414 Z
 OF 12 0610 PIC 252
 LAT 26.7° N, LONG 128.5° E

FIG. 21



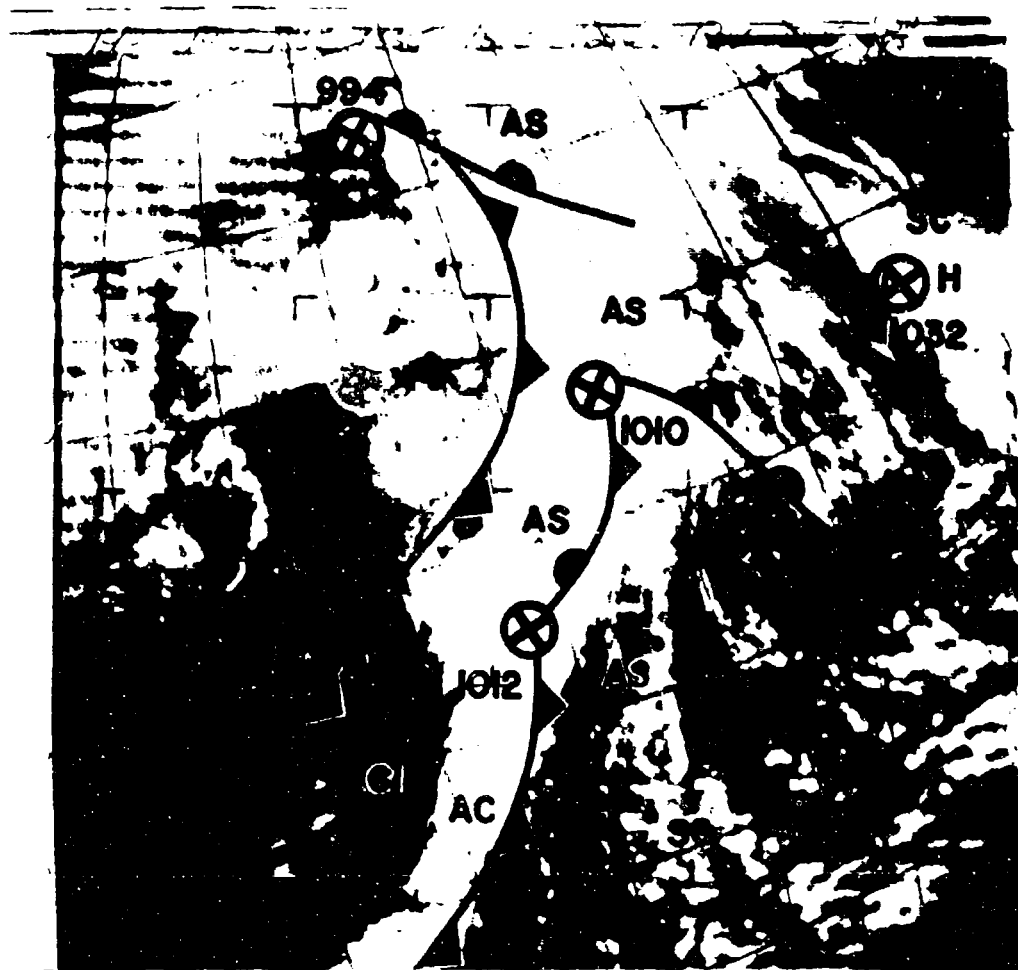


105E 110 115 120 125 130
 FIG. 24
 N. 1005



FUCHU AS, JAPAN
 ESSA 1967
 3004Y 3125116 Z
 ORB: 528K PIC: 3/24
 LAT 30.6 °N, LONG 132.1°E

FIG. 25



135 140E 145 150 155 160 165
 MAY 1967 00:07:29
 1247 861
 415 1639

FIG. 26

48.9 179.4 E
1682 PIC 1017 23MAN 22 34 SL 26.7



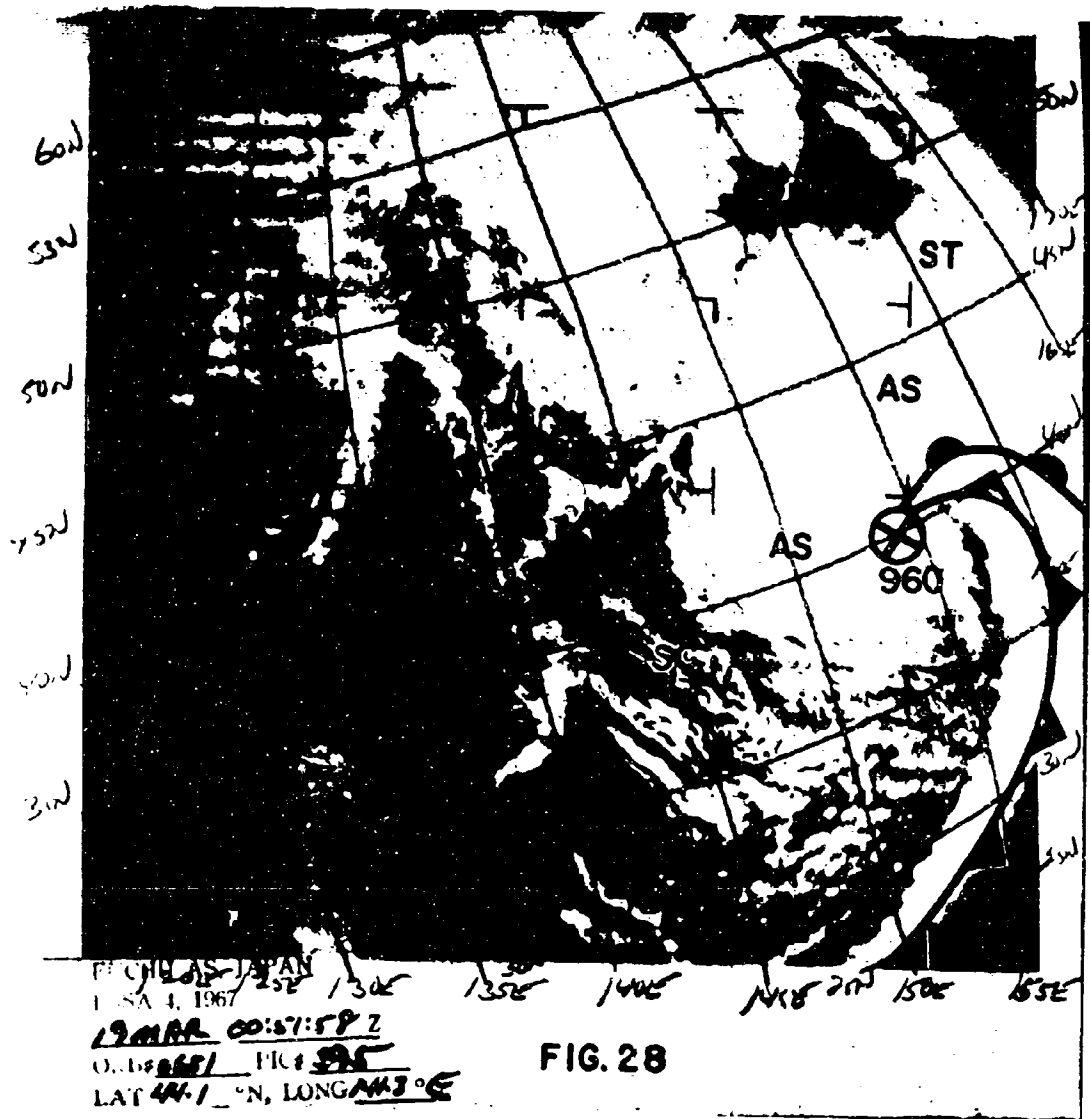
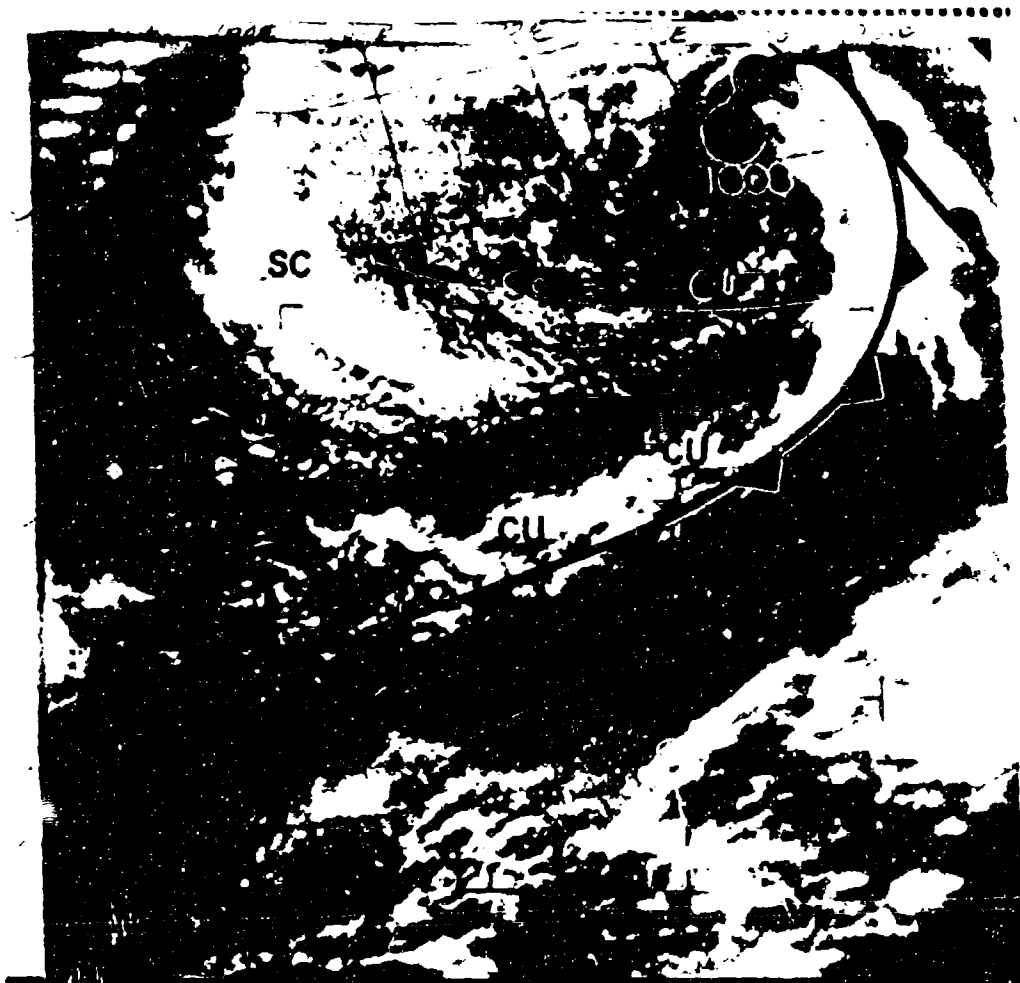
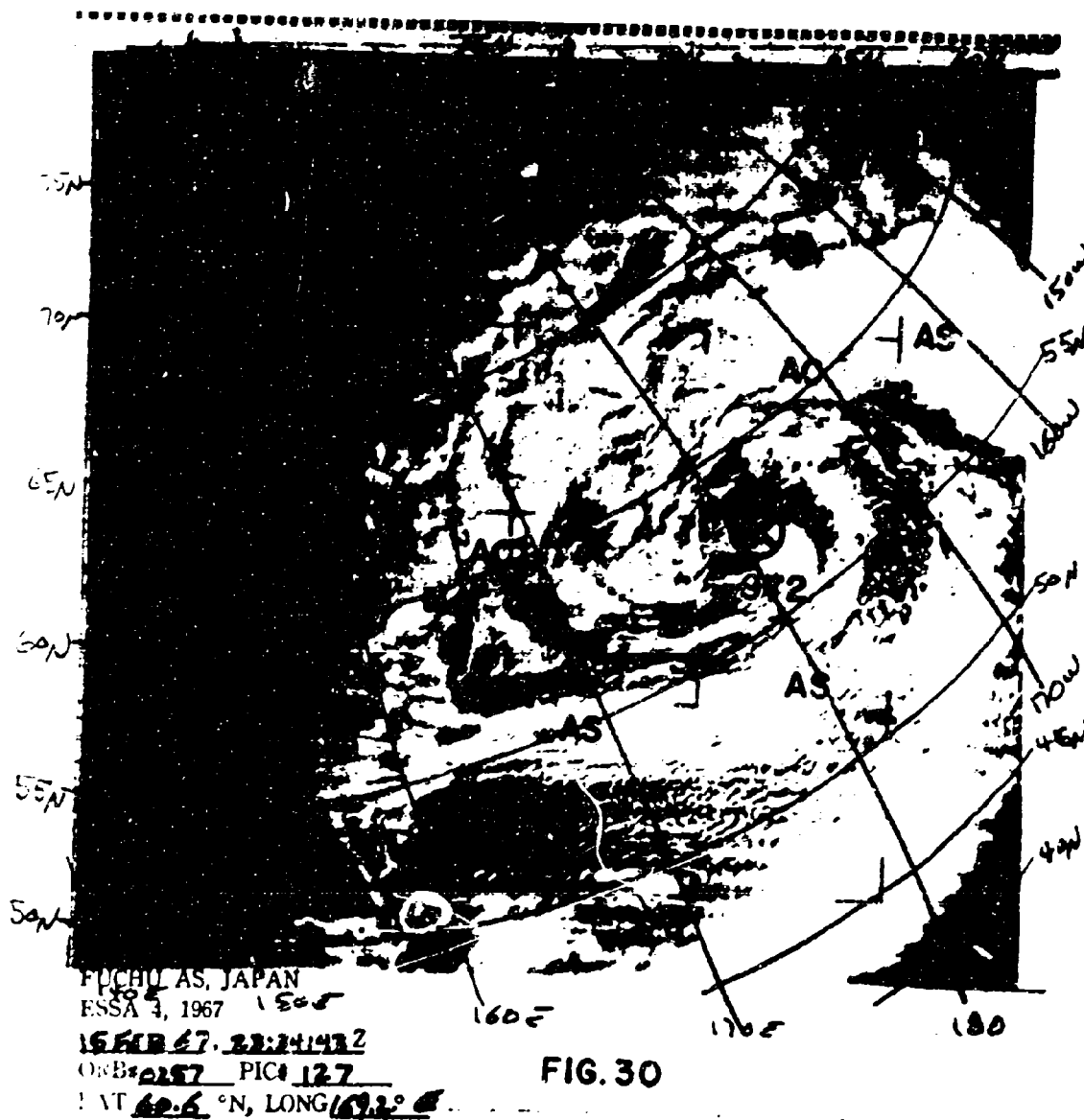


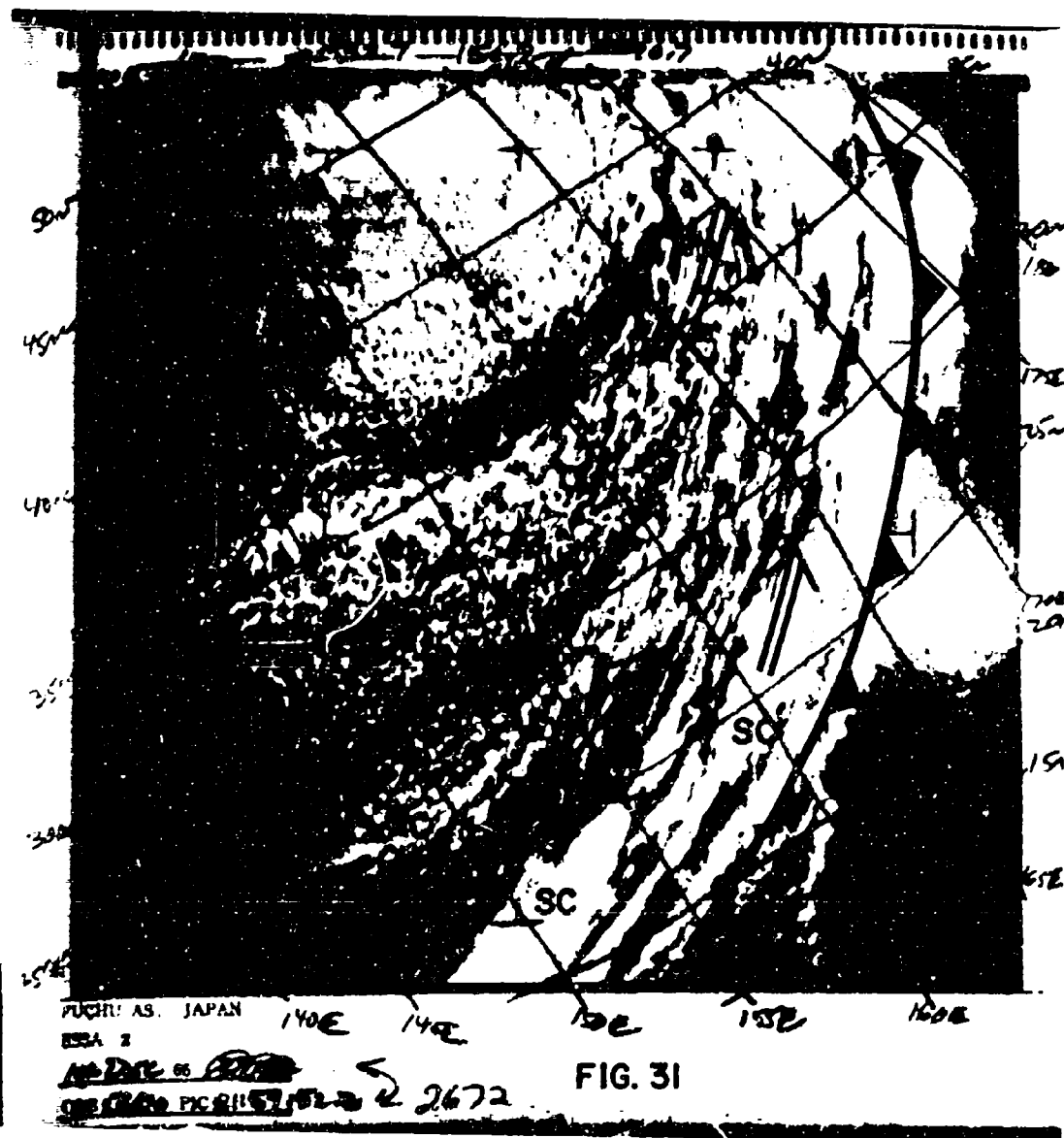
FIG. 28



PACIFIC OCEAN
 155E 160E 165E 170E 175E
 23.02/6.2
 ORB: 1231 PIC: 845
 LAT: 23.6°N, LONG: 164.0°E

FIG. 29





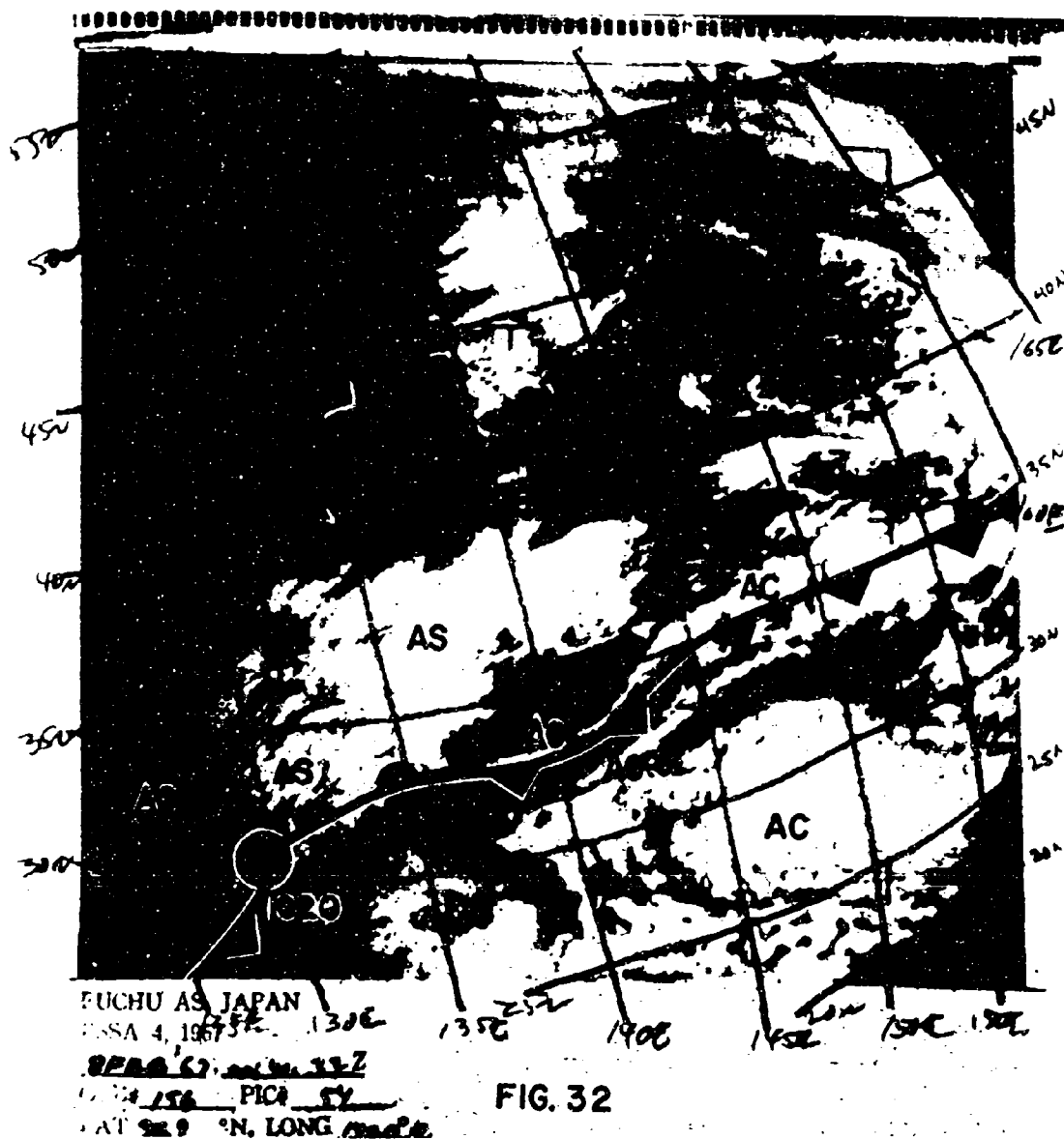


FIG. 32

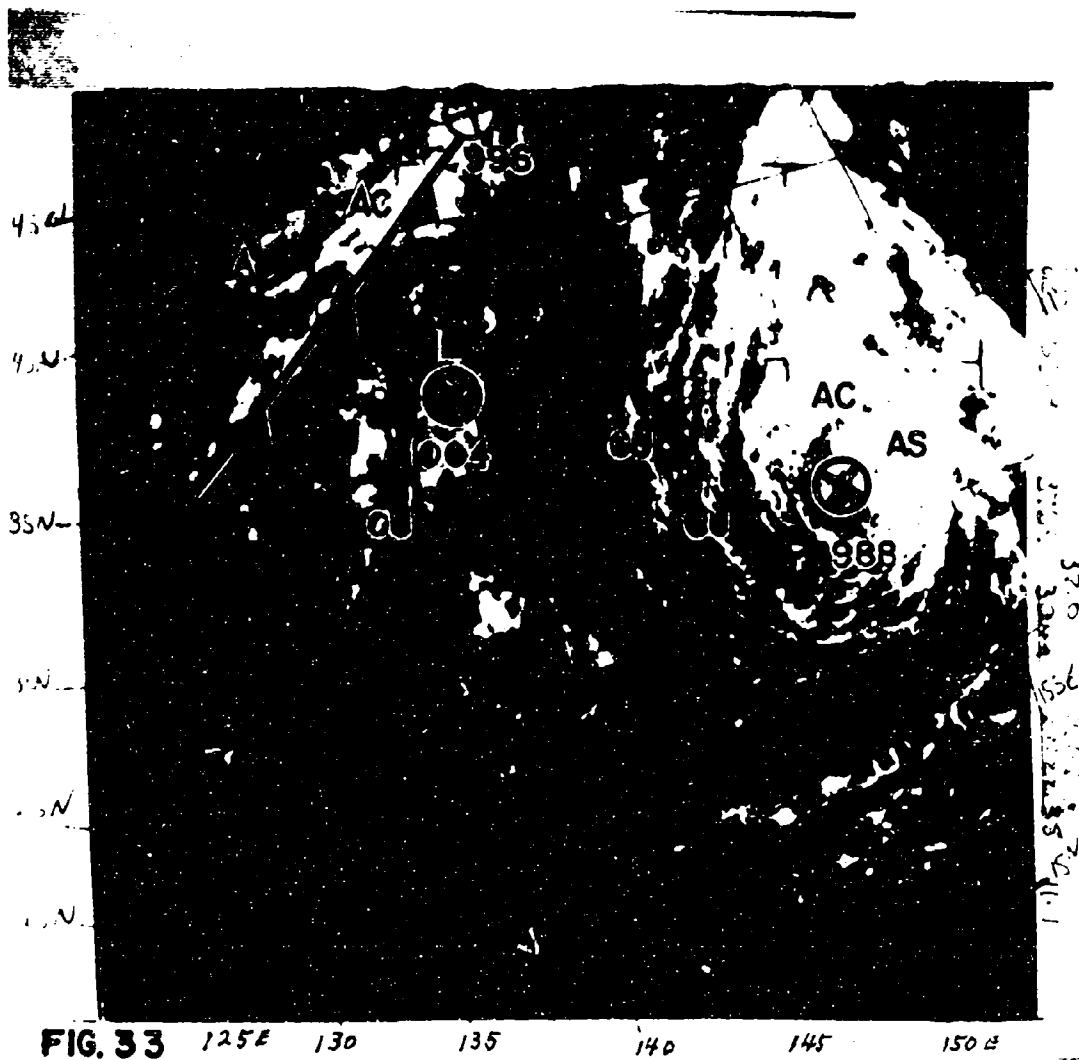


FIG. 33

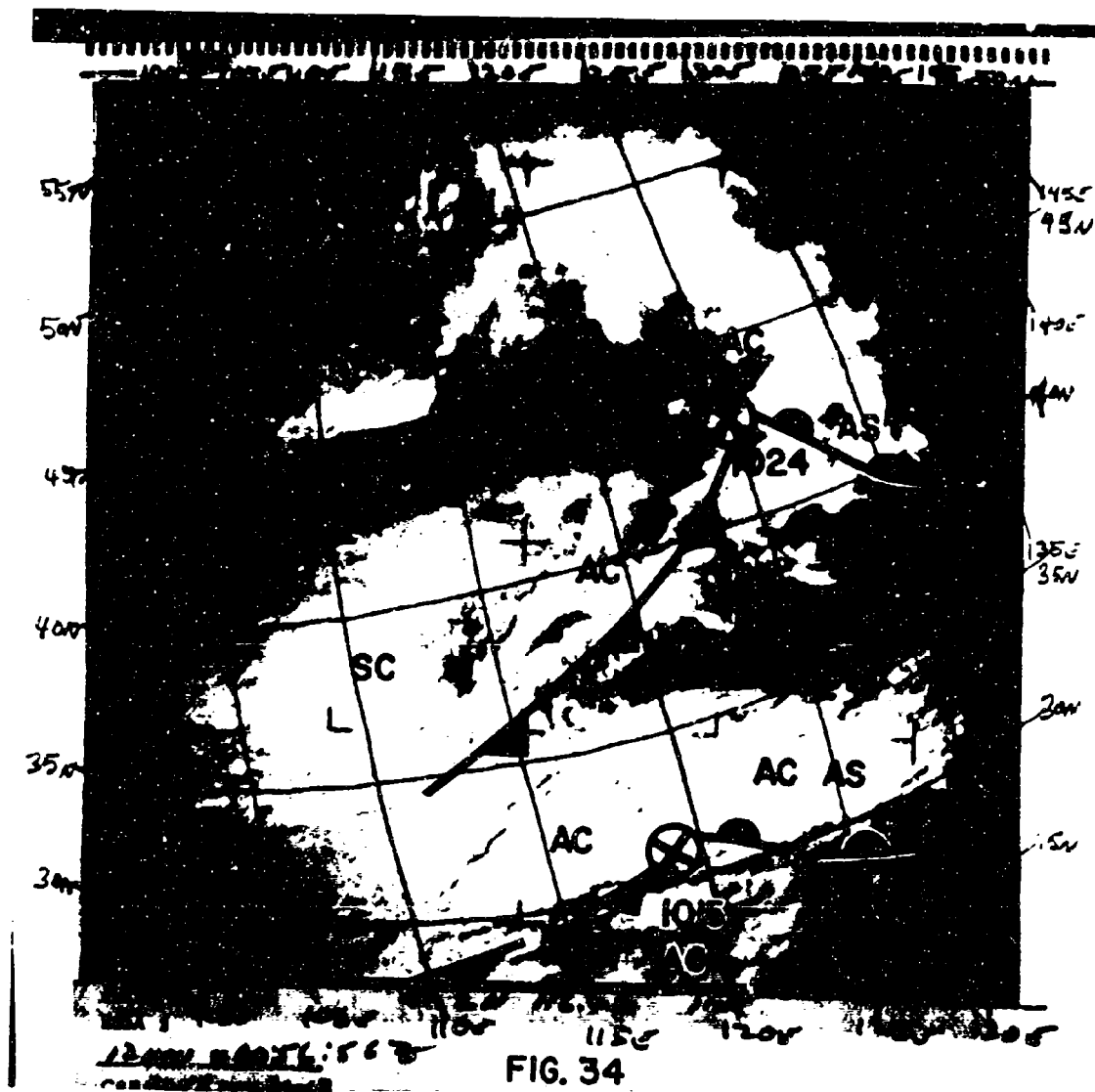




FIG. 35

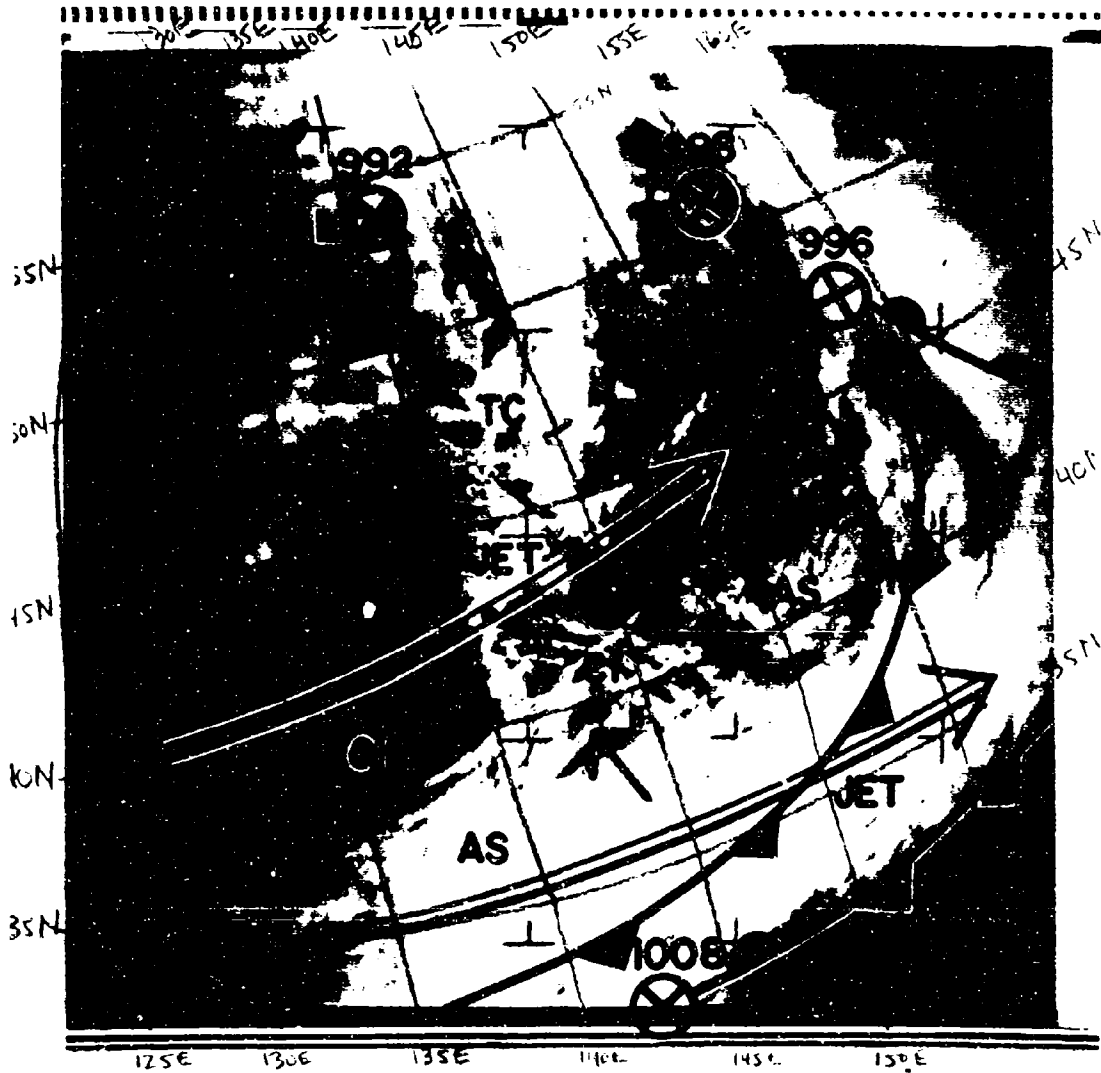
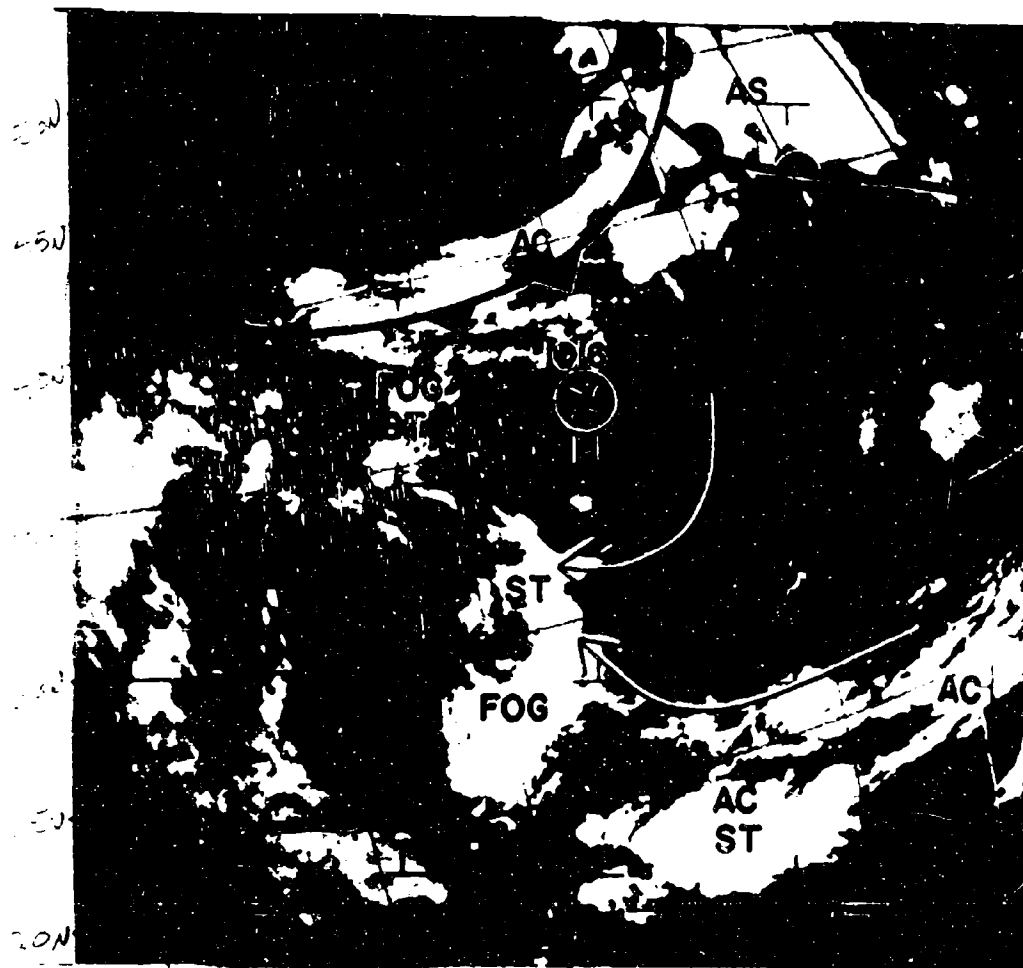


FIG. 36



FUCHU AS, JAPAN

ESSA 4 1967

15 MAR 67 23:48:23Z

ORBIT 2989 PIC 2989

LAT 32.7 N, LONG 124.4 E

FIG. 37





FIG. 39,

145 E

130 "

135 "

160 "

165 "

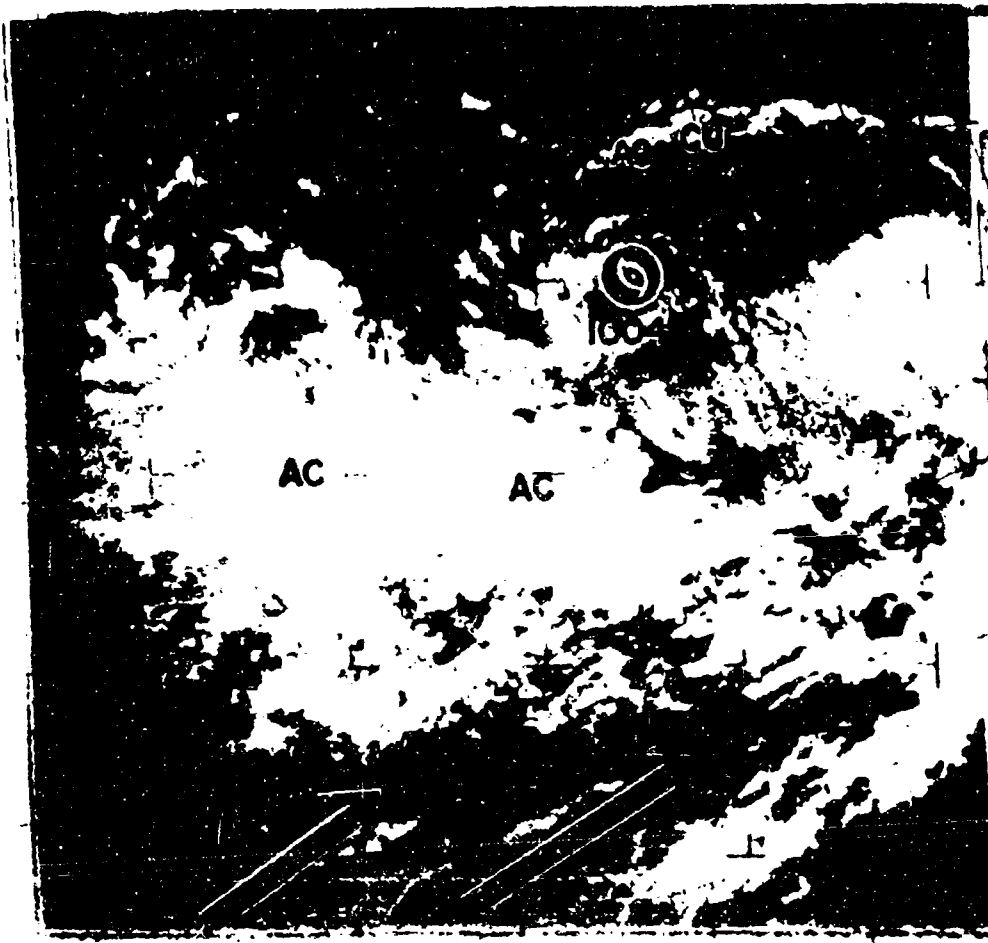


FIG. 40 115E 120 125 130 135

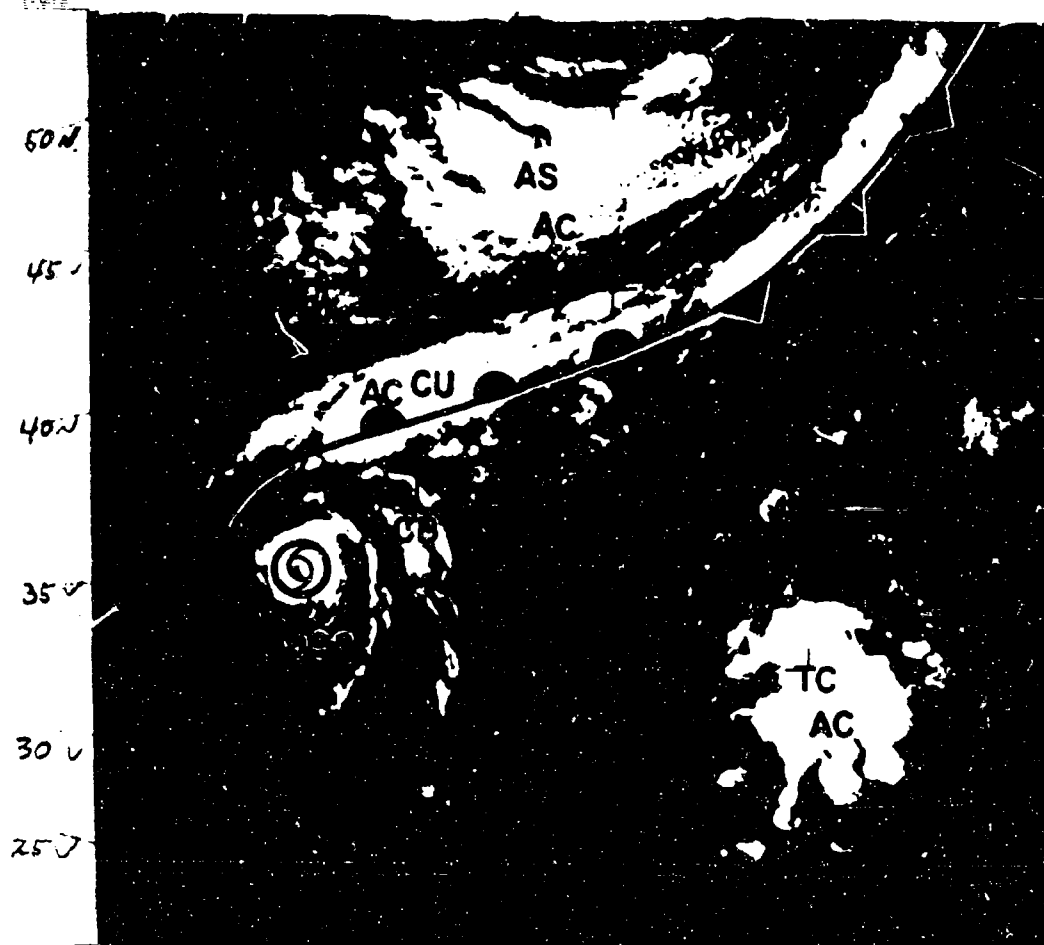
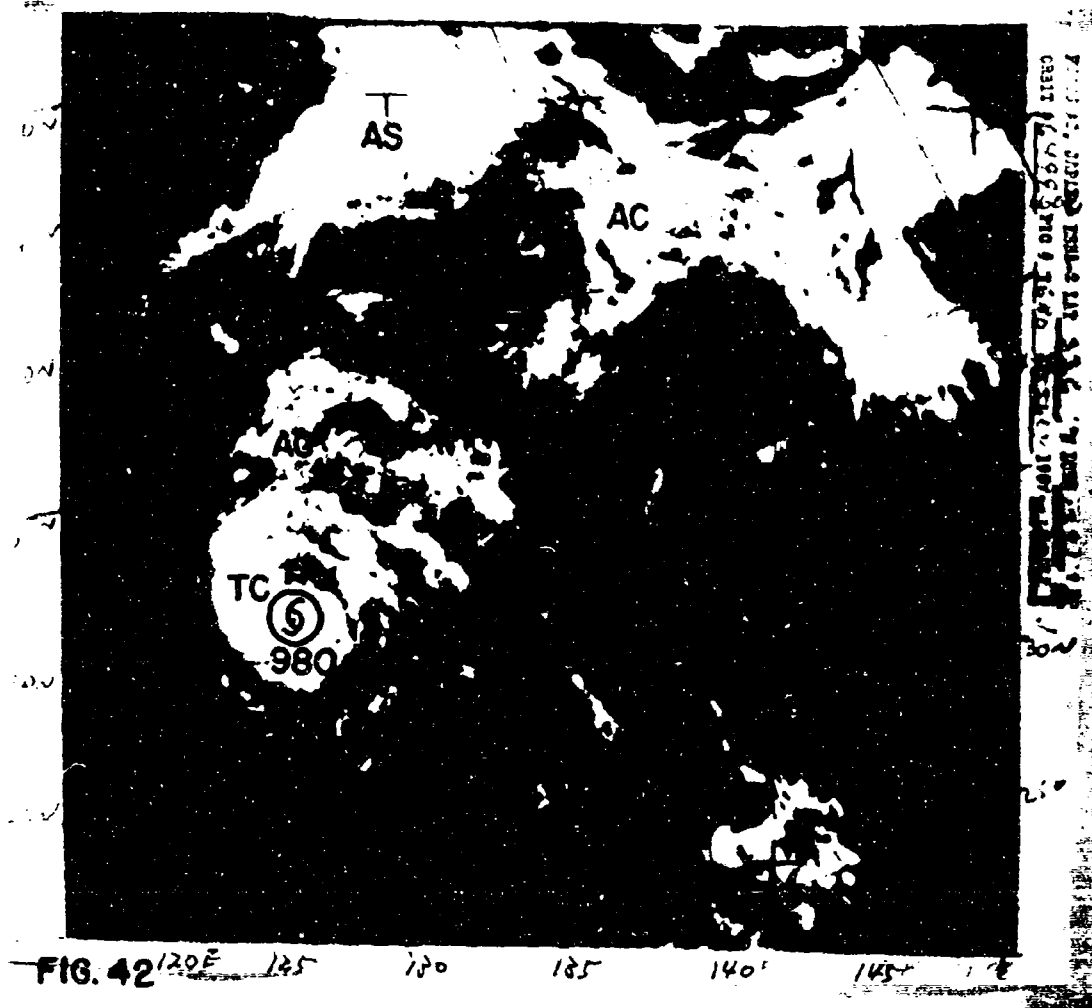


FIG. 41 155 E 160 165 170 175 180



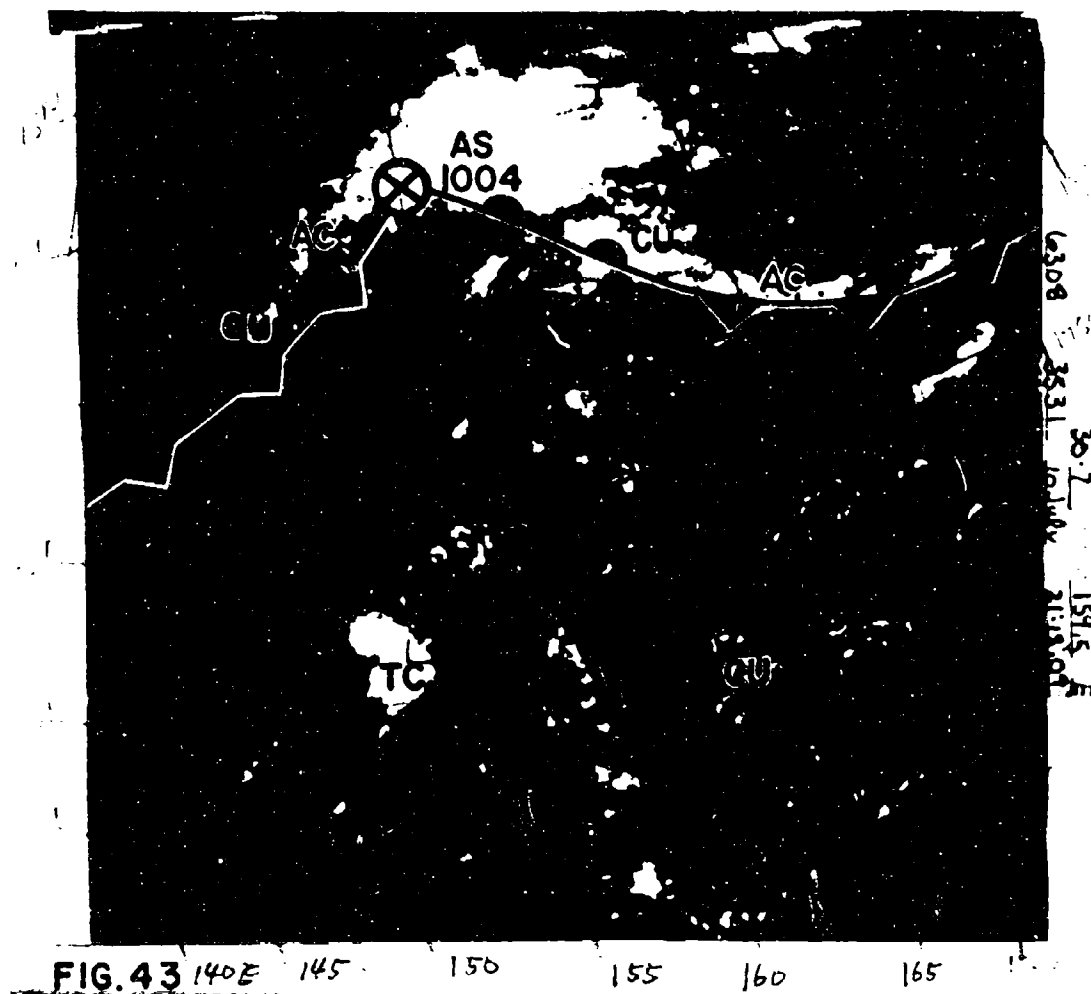




FIG. 44

100 145 150 155 1608

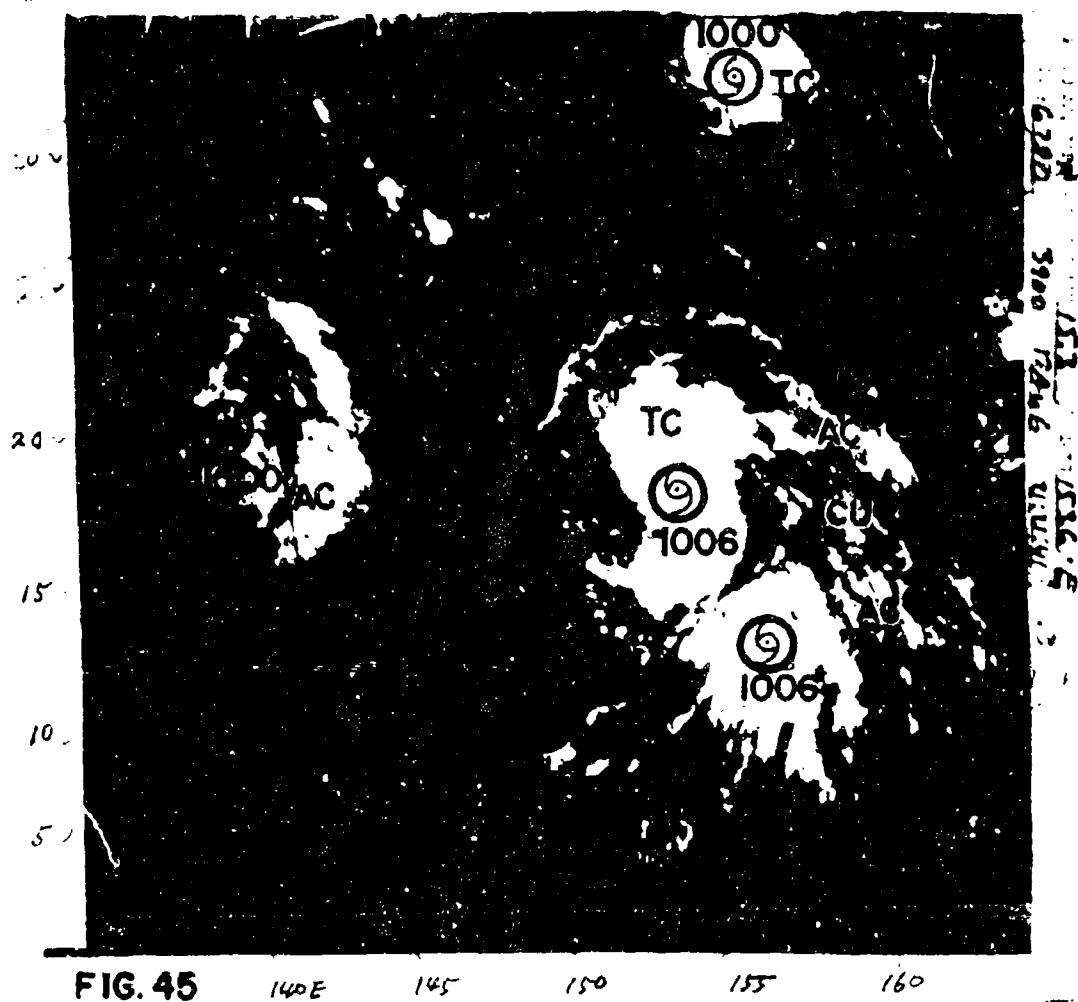


FIG. 45



FIG. 46

921 460 154 117

2023 2023 00:57:39 E 1917

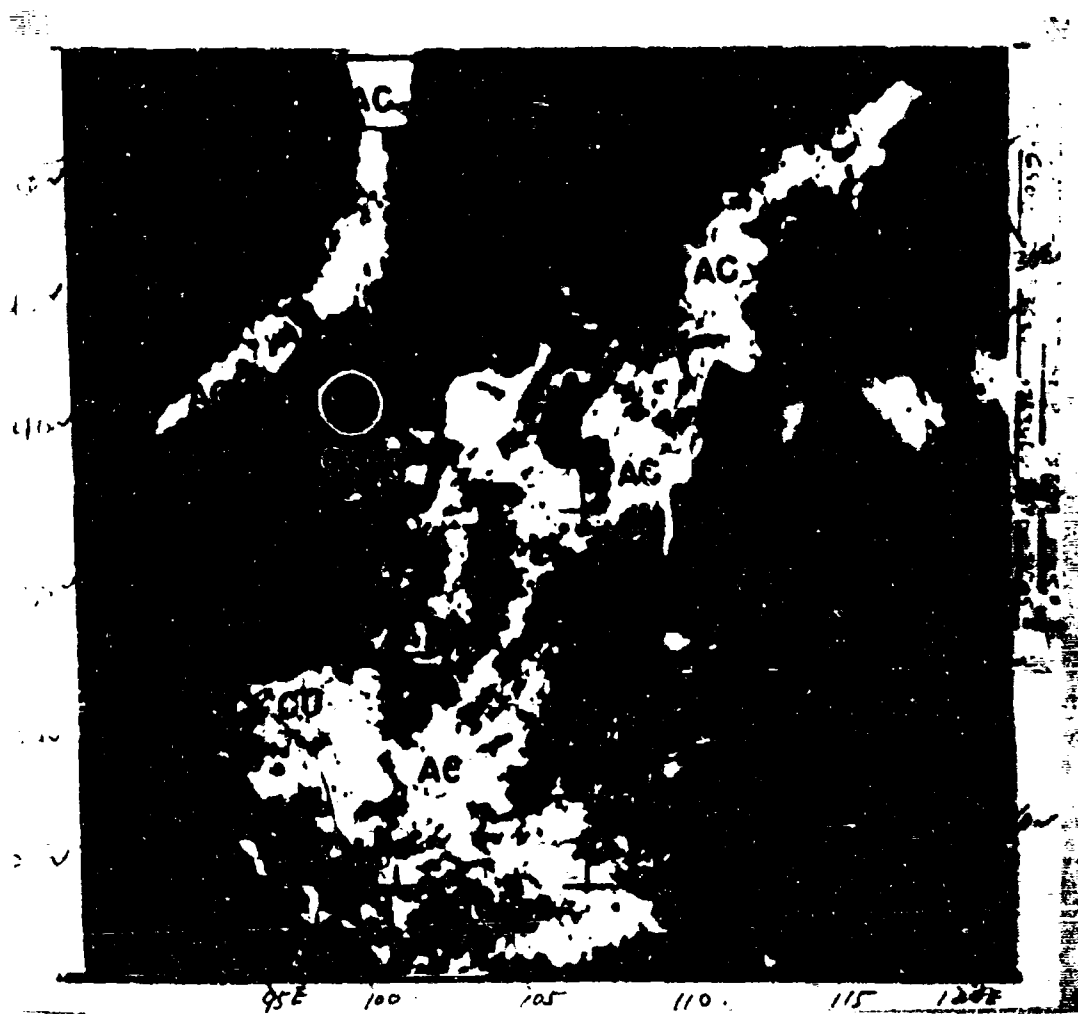


FIG. 48

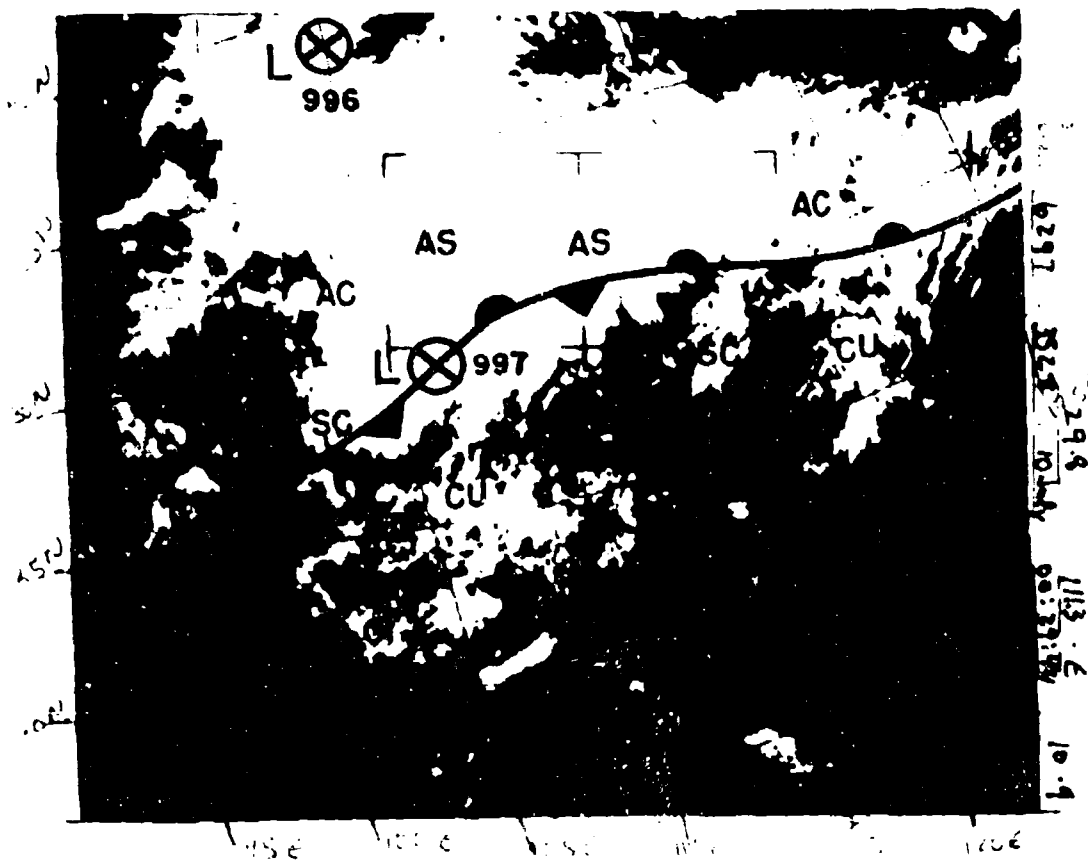


Table 1#. Average albedos (A) in percent for various cloud and terrestrial surfaces as measured from satellite pictures

(MCO - Cloud Cover greater than 80 percent)

	(A)
(1) Cumulonimbus - large and thick	92
(2) Cumulonimbus - small, top estimated 6 km	85
(3) Cirrostratus - thick, with lower clouds and precipitation	74
(4) Cumulus and Stratocumulus - MCO, over land	69
(5) Stratocumulus - MCO, over land	68
(6) Stratus - Approximately 0.5 km thick over ocean	64
(7) Sand - White Sands, New Mexico, USA	60
(8) Stratocumulus masses within cloud sheet over ocean	60
(9) Snow, 3-7 days old covering mountain above timber	59
(10) Stratus - thin, over ocean	42
(11) Cirrus - over land	36
(12) Cirrostratus - over land	32
(13) Cumulus of fair weather - MCO, over land	29
(14) Sand, Valleys, plains and slopes	27
(15) Sand and brushwood	17
(16) Coniferous forest	12
(17) Lake - Great Salt Lake, USA	9
(18) Ocean - Gulf of Mexico	9
(19) Ocean - Pacific	7

* After Conover (1965)

J.

REFERENCES

1. Anderson, R. K., Ferguson, E. W. and Oliver, V. J., The Use of Satellite Pictures in Weather Analysis and Forecasting, WMO Technical Note No. 75. Geneva, Switzerland: World Meteorological Organization, 1965.
2. Hopkins, M. M., Jr., "An Approach to the Classification of Meteorological Satellite Data," Journal of Applied Meteorology, Vol 26, No 1 (1967), pp. 164-178.
3. Lee, R. and Taggart, C. I., A Guide to Satellite Cloud Photo Interpretation. NAVWEARSCHFAC Technical Paper No 1-68. Norfolk, Virginia: Naval Weather Research Facility, 1968.
4. Photographs from Meteorological Satellites, NWRF 33-0667-125. Norfolk, Virginia: Naval Weather Research Facility, 1967.
5. Sadler, J. C., The Tropical Upper Tropospheric Trough as a Secondary Source of Typhoons and a Primary Source of Tradewind Disturbance, Honolulu, Hawaii: Hawaii Institute of Geophysics (HIG 67-12), 1967.
6. Sherr, P. E., Barnes, J. C., Boncher, R. J., Rogers, C. W., and Widger, W. K., Jr., Meteorological Satellite Techniques for the Army, Technical Report, ECOM-02173-4, 1966.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D		
<small>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</small>		
1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION
Scientific Services Hq., 1st Weather Wing APO San Francisco 96553		UNCLASSIFIED
		2b. GROUP
3. REPORT TITLE		
Synoptic Application of Satellite Cloud Pictures Over the Far East.		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
Meteorological Report - Final		
5. AUTHOR(S) (Last name, first name, initial)		
Pak, K.S.		
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
8 Oct ober 1969	62	6
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S)	
9. PROJECT NO.	Technical Study 19	
10.	8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
11.		
10. AVAILABILITY/LIMITATION NOTICES		
This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY
13. ABSTRACT		
<p>This study describes the application of satellite data in daily synoptic analysis and forecasts. General characteristics of the appearance of clouds in satellite pictures are briefly discussed. Rules which are directly useful for daily forecasting are itemized and divided into various terrain effects and synoptic patterns. Selected examples of photographs from ESSA 2 and 4 and Nimbus 2 are discussed.</p>		

DD FORM 1 JAN 64 1473

UNCLASSIFIED

Security Classification

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Weather Satellites, clouds, Far East, interpretation of weather satellite pictures, synoptic application of satellite pictures.						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parentheses immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

Security Classification